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GREAT LAKES INSTITUTIONS: A Survey of Institutions Concerned with the Water and Related Resources in the Great Lakes Basin

Coastal Zone
Information
Center

Great Lakes Basin Commission

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June 1969

Great Lakes Basin Commission
and
Great Lakes Panel of the Committee on
Multiple Use of the Coastal Zone,
National Council on Marine Resources
and Engineering Development

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and Related Resources in the Great Lakes Basin*

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Committee on Multiple Use of the Coastal Zone
NATIONAL COUNCIL ON MARINE RESOURCES
AND ENGINEERING DEVELOPMENT

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Foreword

The Great Lakes Basin Commission and the Great Lakes Panel of the Committee on Multiple Use of the Coastal Zone of the National Council on Marine Resources and Engineering Development have sponsored this publication as an aid to improved planning and management in the Great Lakes area.

The survey was designed to accomplish two purposes. First, it was meant to become a working tool for those actively engaged in studies of the Great Lakes. By providing a listing of institutions and their programs, it was hoped to improve understanding, communication and coordination in planning and management of the lakes and their related land resources. Second, the nature of the survey was established to give it value as an information source for those interested in the lakes and their institutions.

The first section contains résumés of institutions that have programs or responsibilities for some aspects of the Great Lakes. The addresses of these institutions and others are listed in appendix A. The addresses of institutions having planning or coordinating responsibilities are listed in appendix B. A partial listing of useful publications concerning the Great Lakes is given in appendix C.

Marine and lacustrine activities in the Great Lakes are forecast in two periodical publications, one for Canadian work and one for work in the United States, entitled "Directory and Project Forecasts," and are available from the Canadian Committee on Oceanography and Lake Survey District, U.S. Army Corps of Engineers. These projects are coherent units of the program of any agency directed to a definable objective. The person in responsible direct charge is usually reported.

Though efforts were made to contact and include all institutions concerned with the Great Lakes, the present work cannot be considered a complete listing. Readers are encouraged to notify the Great Lakes Basin Commission, Ann Arbor, Mich., of the names and addresses of organizations that have been omitted for inclusion in future revisions.

It may appear from these descriptions that some of the duties of the agencies listed are conflicting or overlapping. This matter will receive further study, as a primary objective of the Great Lakes Basin Commission is to coordinate activities of Federal agencies so as to preclude duplication of work where assigned responsibilities may be overlapping.

Acknowledgment

A survey of this nature could not have been prepared without the help and cooperation received from the institutions listed herein. The time and effort they have given to provide the basic information is greatly

appreciated. Acknowledgment is also made of the efforts of Mr. Jack Horton, University of Pennsylvania Medical School, and Mr. Michael Long, University of Michigan, in preparing this survey.

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Introduction

The Great Lakes represent a natural resource of immense value to the United States and Canada. Their location in the heartland of the North American Continent and their deep water connection to the Atlantic Ocean through the St. Lawrence Seaway and the inter-connecting locks and channels greatly enhance their economic significance. These five huge lakes form a large and complex system that includes its own distinct climate, geography, hydrology, and ecology. They are often referred to as the fourth seacoast, for their size subjects them to forces of oceanographic dimension.

In geological terms the lakes are young. Their present forms were created during the Pleistocene era by the glaciers that moved across the continent. As the glaciers retreated, the lakes underwent various changes before achieving the morphology by which we know them today. The total Great Lakes Basin encompasses about 300,000 square miles of which nearly one-third, 95,000 square miles, is lake surface. Samuel de Champlain, founder of Quebec city and first Governor-General of New France, is credited with the discovery of the Great Lakes in 1615. During the next 200 years, the lakes provided water routes for voyagers and played an important role in the fur trade of North America. After the War of 1812 and the improvement of access routes in the 1820's, the region began to develop at a rapid rate. In 1810 the basin's population was about 290,000 people. By 1910 this had increased to nearly 14,000,000. In 1960 more than 31,780,000 people were residing in the Great Lakes Basin. There is no other region in North America which matches its economic output. Development in the basin is characterized by extensive urbanization and industrialization.

A waterway of over 2,300 miles stretches from the Atlantic Ocean to Duluth, Minn., making ocean ports of the great continental cities along the shores of the lakes. Though the Great Lakes themselves form vast waterways, the shallow connecting channels, with their falls and rapids, had long proven barriers against shipping. Attempts to improve navigation on the lakes began when the North American Fur Co. constructed a small lock on the St. Marys River at Sault Ste. Marie in 1797. The present system of locks at the "Soo" is the busiest in the world and in the 9 months open season carries more traffic than the Panama and Suez Canals combined when operating a full year. Other locks provide passage along parts of the St. Lawrence

Seaway and connect Lakes Erie and Ontario via the Welland Canal.

In 1966 a total of about 246,000,000 net tons moved on the Great Lakes. Of this about 185,000,000 tons were domestic (within the United States or Canada), 47,000,000 moved between the two countries, and about 14,000,000 were overseas traffic. This represented a significant proportion of the waterborne commerce of the two countries. In terms of ton miles, over 40 percent of all traffic on U.S. waterways moves on the Great Lakes.

The Great Lakes also serve as a source of water for municipalities and industry. Some 240 communities located on or near the lakes depend upon them for domestic water supply. In 1966 it was estimated that the water needs of 28 million persons were supplied by the Great Lakes. Some industries receive their water from municipal systems, but the aggregate capacity of industrial pumpage from the lakes is approximately three times the capacity of municipal pumping stations. This combined industrial and municipal pumpage averages 15,600 million gallons per day.

Swimming, fishing, and boating are the region's principal outdoor recreation activities. These activities are especially susceptible to the adverse effects of human activity on the lakes. As an example, prior to the opening of the Welland Canal between Lakes Erie and Ontario, Niagara Falls had been an effective barrier to the parasitic sea lamprey. The canal opened the way for the lamprey to enter the upper lakes, where it nearly destroyed the populations of lake trout, whitefish, and burbot. The commercial fishery of the area nearly collapsed, and sport fishing was severely limited.

Chemical methods to control the lamprey have been developed and are currently being used. The lamprey population has been reduced to 10 and 15 percent of its previous highs in Lakes Superior and Michigan, respectively. Control measures are also being conducted on Lake Huron.

The reduced population of lake trout and burbot—the only abundant and widely distributed predators of the lakes—created conditions favorable to the alewife. Because of the lack of predation, the alewife became extremely abundant. This small herring-like marine fish also gained entrance into the Great Lakes through man's activity. The alewife presently domi-

nates Lakes Huron and Michigan where it has reached nuisance numbers and created objectionable conditions during massive die-offs. Hopefully, control measures, including the lake trout restoration program and the recent introduction of coho and chinook salmon, may restore an ecological balance to the lakes and bring about a return of high-value species.

The lamprey and alewife are not the only problems facing the Great Lakes. The lakes also serve as receptacles for waste waters. Much of the water drawn from them is returned in a polluted condition. Over the past few years, increased demands upon the lakes and the resources surrounding them have increased their problems. With an ever growing pollution load, other water uses are adversely affected, especially recreation and fisheries. Pollution has become a major issue, and water quality is now one of the most serious problems in the Great Lakes. These problems are both local and general, national and international. They include diminished water quality, altered flora and fauna, offended aesthetic senses, threatened human health and well-being, curtailed or precluded recreation, seriously damaged sport and commercial fisheries, and increased danger of irreversible changes in the ecology of the lakes as eutrophication is accelerated. Due to its nature and the population density around its perimeter, Lake Erie has been the first and hardest

hit in terms of deterioration of water quality and conditions in general. However, there are indications that Lakes Michigan and Ontario are also undergoing serious stress.

As the problems concerning the lakes have increased, so have the interests and concerns of people and organizations. This has resulted in increased activity by governments, organizations, and private citizens. In recent years the number of institutions concerned with the Great Lakes has increased dramatically. Missions sometimes are uncoordinated and overlapping and cohesiveness and unity of purpose among these institutions require strengthening.

The purpose of this review is to prepare a contemporary survey of institutions having responsibility for or interest in the Great Lakes which can be used as a tool by these institutions to aid in reducing confusion and improving communication and coordination. In many respects this work represents a revision and expansion of the 1966 edition of "Aquatic Science in the Great Lakes," published by the Interagency Committee on Oceanography, Federal Council for Science and Technology. The present work was compiled by the Great Lakes Basin Commission in conjunction with the Great Lakes Panel of the Committee on Multiple Use of the Coastal Zone of the National Council on Marine Resources and Engineering Development.

International-United States and Canada

Over one-third of the boundary between the United States and Canada transverses the Great Lakes. Because of the nature of the lakes and their importance to the two countries, it has long been recognized that close international cooperation between the United States and Canada in the management and control of the Great Lakes is beneficial to both countries. This cooperation is conducted through two international commissions and other, less formal, institutions.

International Joint Commission

The *International Joint Commission* (IJC) is a permanent body that was established to carry out the purposes of the Boundary Waters Treaty of 1909. It consists of six members, three from the United States and three from Canada. For administrative convenience there is a Canadian section and a United States section, each with a chairman. Offices are maintained in Ottawa and Washington.

The 1909 treaty gives the IJC responsibilities in two general categories.

The first of these responsibilities is to approve—or refuse approval—of all proposals for use, obstruction or diversion of boundary waters on either side of the international boundary which would affect the natural level or flow of the boundary waters on the other side. All of the Great Lakes, except Lake Michigan, and their connecting channels are boundary waters as defined in the treaty. The levels of Lake Superior and Lake Ontario are regulated in accordance with Orders of Approval that were issued by the IJC prior to construction of regulating works at their outlets.

The second general responsibility of the IJC under the treaty is to investigate and make recommendations on specific problems along the common frontier which are referred to the Commission from time to time by the Governments of the United States and Canada. Under this provision of the treaty the two Governments have made requests—or references—to the IJC on such varied subjects as water pollution, air pollution, further regulation of Great Lakes levels and preservation of the American Falls at Niagara.

The treaty specifies the following order of precedence which must be observed in the use of these waters, and directs that no use be permitted which tends materially to conflict with or restrain any other

use which is given preference over it in this order of precedence:

- (1) Uses for domestic and sanitary uses;
- (2) Uses for navigation, including service of canals for the purposes of navigation;
- (3) Uses for power and for irrigation purposes.

These provisions do not apply to or disturb uses of boundary waters existing prior to the signing of the treaty.

When referring a problem for investigation, the Governments usually state that the IJC may utilize the services of engineers and other specially qualified personnel of the technical agencies of the United States and Canada, as well as the information and technical data acquired or to be acquired by such agencies. Thus, the IJC is able to select and deploy the most experienced and competent people in both countries and combine them in joint undertakings.

It is the Commission's usual practice to establish an International Board consisting of qualified personnel from both countries to organize and coordinate the fieldwork and technical studies required. State and provincial officials also may be appointed to such a Board, with the consent of their Governments. Much of the investigatory work is done by governmental agencies, under the general coordination and direction of the International Board. The Board keeps the IJC informed of its activities by frequent progress reports and, on completion of its studies, files a final report.

After releasing the Board's report for study by all interested persons and organizations in both countries, the IJC holds public hearings at which all interests have convenient opportunity to produce evidence and express opinions on the Board's report or on any other aspect of the problem that the Governments have referred to the IJC. Thereafter the Commission formulates its own report and recommendations for submission to the two Governments. The IJC's report is not binding upon the Governments, who have the responsibility for making the ultimate decisions.

Current investigations in the Great Lakes Basin under IJC auspices include:

- (1) Regulation of Great Lakes levels—this is to determine whether further regulation would be practicable and in the public interest. Such further regulation might be done to bring about a more beneficial range of stage for domestic water supply and

sanitation, navigation, power and industry, flood control, agriculture, fish and wildlife, recreation and other beneficial public purposes. Technical studies are under the supervision of the *International Great Lakes Levels Board*. The Board appointed a Working Committee to prepare the necessary data and studies as requested by the reference to the International Joint Commission dated 7 October 1964. In July 1965 the Working Committee appointed three subcommittees to determine the effect of regulation on shore property, power and navigation and a fourth subcommittee to develop necessary regulation plans. A Regulatory Subcommittee was established in September 1967 which is responsible for carrying out the necessary studies of the regulatory works required for various plans of regulation. In June 1968 a Reports Subcommittee was appointed and given the responsibility for preparing the final report which is scheduled for completion by October 1972.

(2) Pollution of Lake Erie, Lake Ontario, and the international section of the St. Lawrence River—to determine whether waters are being polluted on either side of the boundary to the injury of health and property on the other, the sources, extent and locations of such pollution, and the most practicable remedial measures. Technical studies are under the supervision of the *International Lake Erie Water Pollution Board* and the *International Lake Ontario-St. Lawrence River Water Pollution Board*.

(3) Pollution in the Connecting Channels of the Great Lakes Systems—to continue supervision as a means to insure accomplishment of the Water Quality Objectives recommended for these waters by the IJC in 1950 and accepted by the United States and Canadian Governments. Investigations and surveys are under the supervision of the *Advisory Board on Control of Pollution of Boundary Waters, Connecting Channels*.

(4) American Falls at Niagara—to determine what measures are feasible and desirable to remove accumulated talus from the base of the falls, to retard or prevent future erosion and to preserve or enhance the falls' beauty. Technical studies are under the supervision of the *American Falls International Board*, formed in August 1967.

(5) Lake Superior levels and flows—to regulate the water levels and outflows of Lake Superior through operation of a gated structure at the head of the St. Marys Rapids near Sault Ste. Marie, Mich. Technical studies are under the supervision of the *International Lake Superior Board of Control*.

(6) Niagara River remedial works and diversions—to supervise the construction, operation and maintenance of remedial works provided in the Niagara River under the 1950 treaty with Canada. The works allow maximum power diversions around the falls while maintaining Lake Erie water levels and treaty

flows over the falls for scenic purposes. Technical studies are under the supervision of the *International Niagara Board of Control*.

(7) St. Lawrence Seaway and Power Project—to supervise the operation and maintenance of the St. Lawrence Seaway and Power Project and the coordinate regulation of Lake Ontario water levels and outflows. Technical studies are under the supervision of the *International St. Lawrence River Board of Control*.

Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data

The *Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data* (CCGLBHHD) was established in 1953 in the interest of expediting the investigations of Great Lakes problems being carried on by Canada and the United States. The objective of the Committee is to determine, through joint studies by appropriate Canadian and United States Government agencies, mutually acceptable values of basic hydraulic and hydrologic data for the Great Lakes System during the period of record and in the future. The Committee established four subcommittees, Vertical Control, Lake Levels, Physical Data, and River Flow—with representation from both Governments to carry on the studies.

Great Lakes Fishery Commission

The *Great Lakes Fishery Commission* (GLFC) is an international organization established by the Convention on Great Lakes Fisheries which was ratified by Canada and the United States in 1955. The Commission has the following responsibilities:

(a) To formulate a research program or programs designed to determine the need for measures to make possible the maximum sustained productivity of any stock of fish in the convention area which, in the opinion of the Commission, is of common concern to the fisheries of the United States of America and Canada and to determine what measures are best adapted for such purpose;

(b) to coordinate research made pursuant to such programs, and, if necessary, to undertake such research itself;

(c) to recommend appropriate measures to the contracting parties on the basis of the findings of such research programs;

(d) to formulate and implement a comprehensive program for the purpose of eradicating or minimizing the sea lamprey populations in the convention area; and

(e) to publish or authorize the publication of scientific and other information obtained by the Commission in the performance of its duties.

The Commission is composed of four members from each country. The U.S. section of the Commission is assisted by an advisory committee for each lake on which each bordering State is represented by not more than four persons appointed by the Governor with due consideration to the interests of (a) the State agency with jurisdiction over the fisheries, (b) the commercial fishery, (c) the sport fishery, and (d) the public at large.

The Commission is required to make use of existing agencies in the performance of its duties whenever possible. It maintains a small staff or secretariat to carry out administrative and coordinating functions, and supervise contracts. The formulation and coordination of research is carried out through technical committees which have been established for each of the Great Lakes. These committees are composed of representatives from agencies engaged in fishery management or research. Central committees advise the Commission on questions of major importance to the Great Lakes fishery as a whole.

The two Governments are kept informed of the problems faced by the commercial and sport fisheries and recommendations submitted for transmittal to the appropriate agencies responsible for the regulation of the fishery or engaged in research.

Sea lamprey control is carried out by contracting with the U.S. Bureau of Commercial Fisheries and the Department of Fisheries and Forestry of Canada. Regular treatment of streams in which sea lamprey larvae are produced has reduced the lamprey populations in Lake Superior and Lake Michigan and improved the survival of several important species of fish. The control program was extended to Lake Huron in 1966.

Great Lakes Study Group and Federal Inter-Agency Committee

The *Great Lakes Study Group* (GLSG) is an informal international organization including representative of Canadian and United States agencies and institutions engaged in basic and applied research and engineering investigations related to the development and utilization of Great Lakes water resources. The GLSG was formed October 1962 as the Lake Erie Study Group and was later renamed the Great Lakes Study Group in recognition of the members' interests in all the Great Lakes.

The primary purpose of this group is to facilitate the exchange of information and to provide informal coordination among the various research activities relating to the lakes and their basins. The group provides a forum for assisting and coordinating and eliminating duplication. It also sponsors a data repository for the acquisition, storage, retrieval, and dissemination of

basic data. This responsibility is performed by the Great Lakes Regional Data Center of the U.S. Lake Survey, Corps of Engineers, U.S. Army.

The Steering Committee of the GLSG includes a cochairman, an alternate to the cochairman and a secretary from each country. It investigates problems through ad hoc task groups and committees such as the Data Processing Committee, Ships and Facility Schedule Committee and Aid to Navigation Committee, and provides working-level cooperation and forums for research purposes.

The Group is organized under the two cochairmen who serve as chairmen to the respective sections of the Steering Committee. Each presides at Group meetings in his country. Meetings are held semiannually and meeting places are rotated between the two countries.

The U.S. cochairman of the GLSG organized a *Federal Inter-Agency Committee on Great Lakes Research* which has in its membership all U.S. agencies with an active interest in the Great Lakes. This Committee is concerned with keeping the Federal agencies at the working level aware of what each is doing in Great Lakes research, with a view toward prevention of duplication and establishment of cooperative programs. Semiannual meetings are held by the Committee; one in the winter to present detailed plans for the coming year's research and one in the summer to report on the conformance to plans and status of the activities. The Committee furnishes copies of the minutes of its meetings to the GLSG.

International Association for Great Lakes Research

The *International Association for Great Lakes Research* (IAGLR) was formed in 1967 when it was decided that a formal organization was needed to sponsor the Conference on Great Lakes Research that had previously been held under the auspices of the University of Michigan's Great Lakes Research Division and the Great Lakes Institute at the University of Toronto. The stated objectives of the Association are "the promotion of all aspects of Great Lakes research and the dissemination of research information through publications and meetings." Membership is designed to include engineers, economists, sociologists, political scientists, legal experts, regional planners, and psychologists, as well as those in the natural sciences. Conference proceedings are published.

International Field Year on the Great Lakes

The *International Field Year on the Great Lakes* (IFYGL) is a joint United States-Canadian effort to focus hydrologic research on a Great Lake, Lake Ontario. It is a portion of the world-wide Interna-

tional Hydrologic Decade. The project is planned for the period 1968-74 and includes an 18-month period of intensive field investigations starting in April 1971.

The proposed objectives of the IFYGL are to investigate in depth a number of basic physical problems associated with the hydrology, meteorology, physical limnology, and geology of a large lake and its drainage

basin. Lake Ontario was selected as a test site on the basis of the need for scientific information, public interest, representativeness of the lake, quality of data, logistics, and operating costs. It is expected that the knowledge gained from this work will be useful not only in studies of the other Great Lakes but also for many of the large lakes of the world.

Canada

If the Great Lakes are important to the United States, they are vital to Canada. Over 60 percent of Canada's population and economy is concentrated around the rim of the lakes and in the St. Lawrence Basin. The importance of the lakes is reflected in the efforts and studies given to them by Canadian institutions.

Canada Centre for Inland Waters

The *Canada Centre for Inland Waters* (CCIW) is the major Federal interdisciplinary water resources research institute in Canada. It was authorized by the Federal Treasury Board (a committee of the Cabinet) with three Federal departments participating in the development. These are the Department of Energy, Mines and Resources, the Department of National Health and Welfare, and the Department of Fisheries and Forestry (Fisheries Research Board). In addition, the Association of Universities and Colleges of Canada has developed plans for university participation in the work of the Centre. Laboratory and office space will be provided for about 70 professors and graduate students. As part of its designated responsibility for coordinating Federal water programs, the Department of Energy, Mines and Resources coordinates the activities of CCIW and arranges for support facilities for all participating agencies.

The Great Lakes Division of the Inland Waters Branch of the Department of Energy, Mines and Resources is carrying the main responsibility for initial development of the Centre which is located at Burlington, Ontario. The permanent buildings will be completed in stages between 1970 and 1972. Until then, the Great Lakes Division and other components of the Centre are housed in a 25,000-square-foot trailer complex. The present programs of the Centre and the Great Lakes Division involve research into physical, chemical, geological, and biological processes in the Great Lakes. These are directed toward solutions of problems posed by pollution, fluctuating water levels, ice, shore erosion, etc. As the permanent buildings of the Centre are completed, the programs will broaden to include studies of waste treatment processes, hydraulics research, and socioeconomic studies. The programs will increase in geographical scope to include studies of fresh water resources throughout Canada.

A major objective of the Centre's research program is to develop multidisciplinary water quality prediction models of the Great Lakes and other Canadian lakes.

An Advisory Committee to the Centre is now (early 1969) being formed which will consist of representatives of Federal and provincial agencies, universities, and the private sector of the economy.

The Centre has available the new lake research vessel, C.S.S. *Limnos*, designed for research in all aspects of limnology, lake geology, and water pollution. Designed for year-round operation, the *Limnos* has a complement of 27, including 11 scientists and technicians. On board laboratories permit physical, chemical, bacteriological and other biological studies.

Fisheries Research Board of Canada

The *Fisheries Research Board* is a research organization established by act of Parliament for the purpose of conducting basic and applied research on Canada's living aquatic resources, their environment and their utilization.

The Board is under the control of the Minister of Fisheries and acts as Canada's research agent for lamprey research and control for the Great Lakes Fishery Commission. The act requires that "a majority of the members of the Board, not including the chairman, shall be scientists, and the remaining members of the Board shall be representative of the Department [of Fisheries and Forestry] and the fishing industry."

The Board has established the Freshwater Institute on the Campus of the University of Manitoba, Winnipeg, Manitoba, with a special section dealing with problems of eutrophication. The major Great Lakes activity of the Board's eutrophication section is based at the Canada Centre for Inland Waters, Burlington.

Canadian Committee on Oceanography

The *Canadian Committee on Oceanography* (CCO) is an association of Federal Government agencies and universities that are actively concerned in marine science and research and their application to the oceans and large Canadian lakes. It includes four university-based institutes that have formal provisions for pertinent postgraduate education and research.

The purposes of the Committee are to provide a forum and channels of negotiation for voluntary coopera-

tion and coordination of plans, resources, research and applications and exchange of pertinent information. The Committee organizes regional working groups on the model of the CCO to accomplish similar purposes at the regional level. The Great Lakes Working Group was formed in 1960.

Great Lakes Working Group

The basic function of the *Great Lakes Working Group* (GLWG) is to bring together all interested Federal, Province, and university agencies which are carrying out research work on the Great Lakes. This aids them in communicating programs of work, arranging coordination where it is profitable, and in advising the Canadian Committee on Oceanography on policy matters relating to Great Lakes research.

In addition to the semiannual meeting of the members, a field program subcommittee of scientists involved in fieldwork meets annually or more frequently as necessary to exchange information and coordinate the details of fieldwork scheduled for the coming year.

Department of Energy, Mines and Resources

Inland Waters Branch

Great Lakes Division.

The scientific sections of the *Great Lakes Division* are Chemical Limnology, Limnogeology, and Physical Limnology. The Chemical Limnology Section, in cooperation with other agencies, collects and analyzes data of monitoring cruises on the Great Lakes. The section studies trends in chemical composition of lake waters and interactions within the lakes. The Physical Limnology Section has been investigating the circulation and physical properties of Lakes Ontario and Erie in support of the IJC studies on pollution. Programs include temperature, turbidity and meteorological monitoring efforts; measurements of air, momentum, and temperature flux by eddy correlation techniques from an 80-foot tower in Lake Ontario; spectral analysis of water level data in studying the free surface modes of oscillation in the region; temperature and current meter moorings to study upwelling, the "coastal jet" phenomenon, and scales of motion encountered; remote sensing through thermal imagery as applied to pollution and limnological studies, and techniques of value in the furthering of various mathematical models in the Great Lakes. The Limnogeology Section conducts extensive studies in all four of the Great Lakes bordering on Canada, and in other Canadian lakes as required, of the movement and deposition of sediments in lakes, the geochemistry of sediments and the role of the sediments on pollution levels in the lakes. A special program in collaboration with the Fisheries Research Board is designed to determine relationships between bottom fauna and sediment characteristics.

These sections are supported by electronics and mechanical engineering staffs and facilities, a data processing unit, a technical operation section, and in 1968 one major vessel, the C.S.S. *Limnos* was operated by the Marine Science Branch on behalf of the Division. A second large vessel was chartered. At the same time, the Canadian Oceanographic Data Centre provides a vital service in handling the vast amounts of data being collected by CCIW scientists in their Great Lakes program.

As the work on the IJC report on Lakes Erie and Ontario is completed, elements of a long-term research program are developing which involve development of mathematical models for prediction of water quality and aspects of physical, chemical and geological processes in the Great Lakes. The expertise being developed in the Great Lakes studies is also being applied in other major Canadian lakes.

Marine Science Branch

Tides and Water Level Section

The *Tides and Water Level Section* (TWLS) conducts tide and water level studies to provide datum information for hydrographic, geodetic, and legal purposes, and to provide tide and water level data for Government and private uses. This Section is also concerned with several study and work groups dealing with Great Lakes water level and vertical control problems. Activities include long-term water level forecasts, hydrodynamic leveling and the meteorological conditions and manmade structures affecting lake levels.

Presently, about 40 permanent gages are located along the Canadian shores of the Great Lakes and the international section of the St. Lawrence River to provide information for charting, navigation, and other purposes. These gages are maintained by the Water Survey Division of the Inland Waters Branch (Water Survey of Canada).

Flow and water levels of connecting rivers, the St. Lawrence River and tributaries to the Great Lakes are measured by the Water Survey Division, Inland Waters Branch, in a program developed cooperatively with the Province of Ontario. In addition, sediment measurement programs are conducted by the Water Survey. Data are published regularly by the Department of Energy, Mines and Resources.

Department of Fisheries and Forestry

The Canadian *Department of Fisheries and Forestry's* major responsibility in the Great Lakes region is providing manpower to conduct the Canadian sea lamprey control program, providing funds to the Great Lakes Fishery Commission and serving as a member of that commission.

Department of National Health and Welfare

The *Department of National Health and Welfare's* Division of Public Health Engineering is primarily concerned with the problems of water pollution, especially where health aspects are concerned. A significant portion of the Division's recent work has involved pollution studies on the Great Lakes. Current studies on the Great Lakes are being conducted under the auspices of the International Joint Commission. The Division also has the responsibility for pollution control at Federal facilities, carries out basic and applied research, and acts in an advisory capacity to the provinces. The Great Lakes portion of the Department's program is now based at Kingston and Ottawa, but will be moved to the Canada Centre for Inland Waters in 1972. The lake studies (both bacteriological and chemical) undertaken by the Department were largely made from CCIW vessels. In the St. Lawrence River area, the Department utilizes its own small boats.

Department of Public Works

The *Department of Public Works* is responsible for the management and direction of the public works of Canada except as specifically provided for in other statutes. Officers of the Department serve on several boards and committees of the International Joint Commission including the Niagara Board of Control, the American Falls International Board and the International Great Lakes Levels Board. To assess the effects of fluctuating water levels on all shore property, a complete survey and inventory on the Canadian shoreline of the four Great Lakes has been carried out and evaluations are being made.

This Department also carries out dredging and harbor construction works programs in many Canadian harbors and channels. It is also responsible for approval of U.S. Army Corps of Engineers dredging programs in the Canadian part of interconnecting channels of Great Lakes waterways.

Department of Transport

The Meteorological Branch of the *Department of Transport* has weather observing, forecasting, and research responsibilities on the Great Lakes. Active involvement in lakes research was intensified in 1958 when the Climatology Division created a Hydrometeorology Section. Within that section, a separate Lakes Investigation Unit was established in 1961.

The operation of the land networks around the lakes is the responsibility of the Ontario Region, Air Services, Department of Transport. The cooperating commercial vessels are a joint responsibility of the Ontario Region and the Marine Unit of the Basic Weather Division, Meteorological Branch Headquarters. The

Ice Reconnaissance Section of the Basic Weather Division conducts flights over the lakes during winter. Marine Weather forecasts are issued routinely by the Forecast Office at Toronto International Airport.

The Lakes Investigation Unit is responsible for the coordination of lakes research within the Meteorological Branch and actually conducts most of the research projects and special observation programs. The unit is also responsible for cooperation in lakes research with other Provincial, Federal, and international departments and agencies and universities. Many Lakes Investigation Unit projects are in cooperation with other agencies or organizations. The unit has an active program based at the Baie du Dore Research Station (Lake Huron), operated by the Great Lakes Institute of the University of Toronto. This program includes such facilities as lake towers, research craft, and shoreline networks. In another major cooperative effort the Department of Transport (Marine) provides and operates the weather ship and research vessel C.C.G.S. *Porte Dauphine* for the Great Lakes Institute and the Meteorological Branch. The unit also has a program of monthly areal temperature surveys of each of the Great Lakes bordering Canada using the airborne radiation thermometer technique. These data are used, in part, to make monthly estimates of evaporation losses from each of the Great Lakes and this information will soon be added to the monthly basin precipitation bulletins. At the present time much of the effort of the unit is in support of the IJC studies on lake levels and of planning and preparation for the International Field Year on the Great Lakes.

In addition to the Lakes Investigation Unit program, the meteorological and oceanographic aspects of the multiagency wave study of Lake Superior are being handled by the Atmospheric Research Section of the Branch's Research and Training Division.

The Hydraulics Studies Division of the Marine Hydraulics Branch conducts engineering studies, research, and planning related to marine transportation requirements in navigable waterways, particularly the Great Lakes-St. Lawrence River system. The Branch and Division also provide engineering assistance to the International Joint Commission through representation on a number of its investigatory and control boards and their committees, including the International Great Lakes Levels Board and the International St. Lawrence River Board of Control.

A wave climate study has been initiated with joint participation by the Department of Public Works and the Department of Energy, Mines and Resources (in particular, the Marine Sciences Branch). The Wave Climate Coordinating Committee also includes representation from the Department of Transport, the National Harbours Board and the National Research Council. This study will be carried out on a national

scale. Within the Great Lakes, projects have been planned for locations in each Lake, plus further measurements from the C.C.G.S. *Porte Dauphine*.

Other Branches of the Department having functions related to the Great Lakes Basin are: Marine Works, which is responsible for aids to navigation and for public wharves (except those administered by the National Harbours Board); Marine Regulations, which is responsible for pilotage, vessel safety inspection, prevention of oil pollution of Canadian waterways by shipping, and related matters; and Marine Operations, which is responsible for the operation of the Canadian Coastguard, including winter icebreaking. Most of these various departmental activities are managed through 11 district marine agencies. The Great Lakes area is served by the agencies at Prescott, Parry Sound, and Port Arthur, Ontario.

National Research Council of Canada

The *National Research Council of Canada* provides grants to individuals at a number of Canadian universities for research in the Great Lakes, including biological, limnological problems, lake circulation and diffusion, water treatment processes, and water systems analysis. The Council has also provided annual operating grants to support the work of the Great Lakes Institute.

ONTARIO

All of the Canadian waters of the Great Lakes and a portion of the St. Lawrence River lie within the Province of Ontario. This area includes about 41 per cent or 122,000 square miles of the basin, of which about 34,000 square miles are water. About one-third of the total Canadian population lives in Ontario.

Department of Lands and Forests

In 1946 the Game and Fisheries Department merged with the *Department of Lands and Forests*, thereby establishing a unified responsibility for the administration of all living natural resources on Crown lands. The goals of the Department are to: (1) manage the public domain for a sustained and increasing production of resource materials to meet current and projected requirements; (2) provide for the disposition and acquisition of land in accordance with soundly based, long-range land use plans; (3) provide outdoor recreation opportunities through a network of provincial parks and a fish and wildlife management program, and (4) provide advice and assistance to owners of land so that they may realize or provide the benefits resulting from management.

Department activities in the Great Lakes related to fisheries involve evaluation and assessment of the commercial fishery, licensing for recreational and commercial fishery purposes, management of natural stocks, lake rehabilitation through planting of hatchery

stock, experimental trawling, and research in fishmeal production.

The Department's Research Branch assesses and undertakes research needs of the Department in areas not covered by other research agencies, and determines the fundamental facts on which natural resource management should be based, methods to be used in production and maintenance of these resources, and yields to be expected in quality and quantity from specific treatment. Its investigations include research on fish populations, assessment of the effect of residual lamprey populations on natural spawning, selective breeding of the brook trout-lake trout hybrid (splake) for the rehabilitation of the Lake Huron fishery, and research into influences of environmental changes on the fishery. The Research Branch is responsible for general research in Lakes Huron, Erie and Ontario.

The Department has a continuing program of acquisition of private lands for recreation, wildlife management, parks, etc. A substantial part of the land purchases for these purposes front on the Great Lakes in southern Ontario in order to meet the public demand for access to water. Approximately 200 small boat anchorages comprising Crown land have been reserved for public use.

The Fish and Wildlife Branch is involved in fish monitoring programs, exploratory fishing operations and industrial development projects. Studies concerned with pesticide levels in fish and the effects of thermal pollution on the environment are either planned or in progress. Two special fisheries management units, one on the Bay of Quinte and the other on Lake St. Clair, have been established. Other similar units are planned for the Great Lakes.

Hydro-Electric Power Commission of Ontario

The *Hydro-Electric Power Commission of Ontario* is a corporate self-sustaining public enterprise endowed with broad powers with respect to electricity supply throughout the Province of Ontario. It operates under the Power Commission Act passed in 1907, as amended.

The Commission is engaged in limnological investigations related to the development and operation of hydroelectric, thermal, and nuclear generating stations. Present activities include investigations of lake currents and temperature, formation of ice and extension of ice cover, observations of weed growth, and chemical and biological investigations. Investigations are made at existing generating stations, as well as at sites selected for future development on the shores of Lakes Huron, Erie, and Ontario, and on the St. Clair and Niagara Rivers. In the past the scope of the investigations was limited. Their main purpose was to provide basic data for the design of certain hydraulic structures. The future program is likely to be expanded in the general environmental field.

The Commission is also active in connection with the IJC studies on control of Great Lakes levels.

Ontario Water Resources Commission

The *Ontario Water Resources Commission* (OWRC) administers an extensive program on pollution control and water resource protection directed primarily toward the control of municipal and industrial waste. It has a major responsibility for construction and operation of waste and water treatment facilities and for enforcement of antipollution legislation. The Commission is authorized to build, finance, and operate sewerage projects at municipal request, subject to cost recovery through user service charges. The Commission may also direct municipalities and industries to provide treatment facilities which will meet Commission approved objectives.

In the Great Lakes, the Commission is giving increased attention to the analysis of lake waters in near-shore major-use areas. Locations where uses conflict are being given priority to permit development and application of water loading limits. The OWRC also actively participates in IJC pollution studies in the Great Lakes and interconnecting channels.

UNIVERSITIES

University of Toronto

The Great Lakes Institute of the *University of Toronto* is an integral part of the School of Graduate Studies. The Institute is so organized that its facilities are available to other agencies or individuals working on the lakes.

The Department of Transport operates the research ship, C.C.G.S. *Porte Dauphine* for the Institute. This

vessel has a range of 3,000 miles, a crew of 18 and six technicians, and can accommodate up to eight scientists in addition to the permanent staff. The *Porte Dauphine*, on her research work, sails approximately 25,000 nautical miles a year and operates all year round.

The Institute maintains a fleet of five equipped launches and operates them on behalf of university researchers. It also maintains a research station at Baie du Dore on Lake Huron which provide facilities for limnological research. Facilities include a sheltered harbor to accommodate small vessels of up to 4-foot draft, and living and working quarters for 22 men and six women.

University of Waterloo

Research in a wide variety of topics in water resources is coordinated by the *University of Waterloo*, Water Resources Institute, with individual membership from the Faculties of Engineering, Physical and Life Sciences, and Geography. In particular, research in physical limnology is principally carried out in the Department of Mechanical Engineering with a further contribution from the Physics Department. The main emphasis is on mixing processes, windrows, surface and internal wave phenomena, coastal jets, dynamics of lake currents and sea-air interaction. Programs in the Department of Biology include biological and ecological studies of water within the Great Lakes Basin and specific projects on the Great Lakes themselves.

Other Universities

The Universities of McMaster, Western Ontario, and Windsor are known to have active programs related to the water resources of the Great Lakes.

United States

Fifty-nine percent, or 176,000 square miles, of the Great Lakes Basin lies in the United States. This comprises about 4 percent of the country's land area. About 115,000 square miles is land; the rest is water. It is an urbanized, industrialized region containing 14 percent of the Nation's population. About 80 percent of the 29 million inhabitants are classified as urban residents. In 1963, manufacturing activities in the basin exceeded \$40 billion—almost one-fourth of the Nation's total.

Although the U.S. portion of the Great Lakes is owned by the States, the Federal Government has definite statutory responsibilities in the basin, and both Federal and State institutions are active in planning and management in the Great Lakes Region.

U.S. Department of Agriculture

The *Department of Agriculture* (USDA) investigates agricultural, rural and upstream water and related land resource problems and need for development. Consideration is given to the interrelationships of the upstream, downstream, and interlake needs and problems. The problems analyzed include flood water and sediment damage to rural lands and properties and contribution to damage of downstream areas, impaired drainage of agricultural lands, agricultural drought problems and irrigation requirements, water needs for livestock and rural domestic use, and, in addition, water needs for recreational use, fish and wildlife habitat improvement, and water requirements for agricultural-based industries.

The Department analyzes potential water and related land resource development in the upstream areas, including an analysis of water storage capacity, the effect of land use and management practices on water quality and flow characteristics, and the potential hydrologic effect of agricultural, rural, and upstream developments.

The USDA appraises the economic effects and consequences of development alternatives on the agricultural and related sectors of the economy, as well as beneficial or adverse effects of alternative combinations of structural and nonstructural measures as they relate to the scale of development and the resulting effect on economic activity and growth.

The water resource planning and development activities of the Department are carried out principally through its Soil Conservation Service, Forest Service, and Economic Research Service in coordination with other agencies to avoid duplication. Other agencies within the Department have been authorized either by legislation or Executive Order to work in the fields of conservation, use and quality of the Nation's fresh water resources which bear on the broad field of oceanography. The Secretary of the Department is a member of the U.S. Water Resources Council.

Agricultural Research Service

Soil and Water Conservation Research Division

This Division is engaged in a national program of research on soils, water, and watershed engineering. Included are investigations of amount, rate, and distribution of runoff and streamflow in relation to precipitation patterns, soils, and land use of agricultural watersheds; ground water recharge; stream channel stabilization; amount, origin, transport, and deposition of sediments; engineering design of conservation structures; irrigation technology and water requirements; methods and materials for surface and subsurface drainage; erosion mechanics and prediction of erosion rates; tillage methods, earth-moving techniques, plant nutrition, cropping systems, and other land management practices for watershed protection; water demand for leaching of saline soils; physiologic processes and climatic and soil factors relating to use of water by crop plants; phreatophyte control; application and diffusion of pesticides; water harvesting by chemical treatment or plastic covering of ground surface; reservoir evaporation suppression by chemicals and other means; evapotranspiration from agricultural lands and energy-balance phenomena related to water evaporation; snow accumulation and melting.

Agricultural Stabilization and Conservation Service

This Service is interested in protection of water supply sources and conservation of soil and water through production and cropland adjustment programs and Agricultural Conservation Program cost-sharing with individual farmers. The cost-sharing program includes such on-farm measures as terracing, stripcropping, water control structures, streambank control measures,

small storage dams and reservoirs, agricultural drainage, and protective vegetative cover and tree planting for soil and water conservation.

Economic Research Service

This Service participates in comprehensive river basin planning and engages in research on the economics of natural resource use and development. In comprehensive river basin investigations, the Service develops baseline projections of agricultural production, land use, and employment and income; analyzes agricultural demand for land and water and economic needs for development; and evaluates the economic impacts and implications of water resource development alternatives on the agricultural and related sectors of the economy. This Service also carries out economic research on farm production, marketing, and rural development.

Farmers Home Administration

The Farmers Home Administration makes loans and grants for the construction of rural community water and waste disposal systems serving rural residents. Loans are also made to local organizations to help finance irrigation and recreational facilities and watershed projects. Grants are available to assist communities which currently are without the resources to pay for the development of official comprehensive water and sewer plans in rural areas.

Forest Service

Division of Flood Prevention and River Basin Programs

This Division is involved in flood prevention and river basin planning on State and private forest lands; hydrology; watershed management practices, planning, and design, including effects of sediment and erosion control, irrigation, planting and terracing, reforestation, grazing control, and fire control.

Division of Watershed Management

This Division's interest is in all phases of managing the soil and water resources of National Forest System lands; soil and hydrologic surveys; municipal supply watershed management; increasing water yields through snowpack management and vegetation manipulation; water quality management; restoration of deteriorated watersheds; watershed protection; erosion control; water rights for national forest management; and coordination of water resource development projects with other National Forest System approaches.

Division of Watershed, Recreation, and Range Research

This Division is interested in water yield improvement; reduction of water losses by manipulation or removal of vegetation; soil-plant-water relationships;

phreatophyte control; snow management; evapotranspiration from forest lands; watershed protection and erosion control; watershed rehabilitation; reforestation; engineering methods for soil and water control; stabilization of mountain stream channels; logging operations that provide maximum watershed protection; and the behavior and control of environmental contaminants that could adversely affect the soil and water of forests and ranges.

National Agricultural Library

The Library is interested in publications on the conservation of water as a natural resource; water pollution; water as related to agriculture, e.g., irrigation, harvests, and effect on plants, soils, and animals; drainage; flood control, hydrology, and watershed management.

Soil Conservation Service

The Soil Conservation Service acts as the technical service agency of the Department of Agriculture in the field of soil and water conservation, watershed protection and flood prevention, and resource development, except on lands administered by the Forest Service. It is responsible for administration of programs for watershed protection and flood prevention in the conservation, development, utilization and disposal of water in upstream watersheds and activities in connection with river basin investigations. It represents the Department in interagency planning and coordination activities. It administers programs of financial and technical assistance in water and related land resource development to States and local organizations in the small watershed projects. Assistance is provided for such purposes as watershed protection, flood prevention, agricultural water management, recreation, fish and wildlife, municipal and industrial water supply, and water quality management. A broader assistance program to individual landowners and groups is provided through soil and water conservation districts to plan and carry out soil conservation and water management measures. Technical facilities include hydrology, soil surveys, erosion control, water yield and use, sedimentation, snow survey and water supply forecasting, in addition to engineering and economic planning of water and related land resources measures.

U.S. Department of Commerce

The Secretary of Commerce is an associate member of the U.S. Water Resources Council.

Business and Defense Service Administration

The *Business and Defense Service Administration* (BDSA) was established by the Secretary of Commerce in 1953 to promote and develop the growth of U.S. industry and commerce and to prepare and execute plans for industrial mobilization readiness. The

agency has four major program areas: Industrial analysis, domestic business policy, technical business services and defense production and industrial readiness. In addition to promoting industry and commerce in the Great Lakes Basin, BDSA also encourages business participation in the achievement of national goals, including pollution abatement.

BDSA is participating in the preparation of the Great Lakes Basin joint comprehensive plan by investigating industrial water requirements and the effect on withdrawal requirements of industrial growth, technological changes, and industry water conservation practices.

Economic Development Administration

Public Law 89-136, 89th Congress, S. 1648, was approved on August 26, 1965. The Congress, recognizing that some regions, counties and communities were not sharing in our national growing prosperity, created the *Economic Development Administration* (EDA) under the Commerce Department to cooperate with the States within such areas and regions of persistent unemployment and underemployment to enable such areas to help themselves. Public works grants, loans, planning and other technical assistance are available to States and political subdivisions, Indian tribes, and public and private nonprofit corporations, and loans and loan guarantees are available to individuals to allow the establishment of prosperous diversified local economies and improved local conditions.

Environmental Science Services Administration

As a part of its weather forecasting service, the Weather Bureau of the *Environmental Science Services Administration* (ESSA) provides special forecasts for shipping and recreational boating interests over all the Great Lakes. Forecasts cover general weather, but emphasize wind and wave conditions. The forecasts are made each 6 hours on a regular basis, with intermediate warnings as appropriate. Special forecasts also are made of the probable time of break-up of ice in the lakes and the resulting opening of the navigation season. Other forecasts cover the setup or rise in lake levels due to wind stress on the water surface. Supporting research is conducted in all areas.

A research program is exploring the possibility of modifying the severe "lake-effect" storms which produce heavy snowfall along the southern shores of Lake Erie and Lake Ontario. One approach being tested is the use of cloud seeding to reduce snowfall rates along the shorelines and redistribute the snow farther inland over a wider area.

Maritime Administration

The *Maritime Administration* was established by organic legislation and placed under the jurisdiction of the U.S. Department of Commerce. Under the Mer-

chant Marine Act, 1936, as amended, the Administration is responsible for five groups of programs: (1) financial assistance to shipping, which includes operating and construction subsidies, ship replacement, vessel mortgage insurance, and cargo preference; (2) maritime operations, including reserve fleet maintenance, ship exchanges, charters and transfers; (3) maritime promotion, which involves cargo promotion and port development; (4) maritime training, which includes operations of the U.S. Merchant Marine Academy and responsibilities for the five State maritime academies, and (5) research and development, devoted to new systems development and to cost-reduction projects.

The Maritime Administration has responsibility for promoting the development of U.S. ports and related transportation facilities in connection with waterborne commerce including (1) investigating territorial regions and zones (hinterland) tributary to ports taking into consideration the economics of transportation by rail, water, highway, air, and pipeline and the direction of the flow of commerce; (2) advising and assisting communities on the advantages of port improvements and the appropriate location, construction, and types of marine terminals and their cargo handling facilities in order to achieve the most economical transfer of cargo between land and water carriers in connection with the flow of domestic and foreign commerce, and (3) developing estimates of national port needs and preparing long-range plans, as required, to the end that adequate port facilities may be established for handling the foreign and domestic waterborne commerce of the United States.

Under contract with Southern Illinois University the Administration has an ongoing study, entitled "Port and Shipping Systems on the Great Lakes," to (1) assemble both technical and nontechnical information regarding all phases of activities in Great Lakes ports; (2) show the influence of the St. Lawrence Seaway in forming and reforming the ports and their waterborne directed functions, and (3) give extensive details on many economic matters affecting a large number of Great Lakes ports, including investigation of territorial regions and zones tributary to such ports.

Office of Business Economics, Regional Economics Division

The *Regional Economics Division* of the *Office of Business Economics* (OBE) was established by the U.S. Department of Commerce in 1964. The Division undertook to provide for the Water Resources Council a consistent set of projections of income, employment and population for local areas throughout the country. These projections are intended to serve as the economic basis for planning the development of water and related land resources in various areas of the Nation.

The Division is also participating in the Comprehensive Study of the Great Lakes under the auspices of the Great Lakes Basin Commission. As part of that study, the Division will study certain industries which are of major economic importance in the area and which affect its water resources. Also, analysis will be made of the economic impact of alternative water development proposals.

U.S. Department of Defense

The Secretary of the Army is a member of the U.S. Water Resources Council.

Army Corps of Engineers

The U.S. Army *Corps of Engineers* (CE) has been the Federal Government's principal water resources development agency since 1824. It acts under authority of general and specific congressional legislation. Through its civil works programs the Corps carries out a basin-wide comprehensive water resources planning, construction, and operations effort in cooperation with all other interested agencies of government at all levels—Federal, State, and local—and a wide range of civic and private interests. The civil works program is directed toward the coordinated development of the water resources of the basin in a manner which will lead to the satisfaction of all water-related requirements, both immediate and long range. These include flood control; navigation; hydroelectric power generation; municipal, industrial, and agricultural water supply; water quality control; recreation; and the conservation of fish and wildlife.

In the Great Lakes area the Corps, through its Division and five district offices, plans and constructs flood control projects, navigation channels, harbors, and protective works for the prevention of beach and shore erosion. Its work includes investigating ways and means to preserve and enhance the scenic beauty of Niagara Falls, where the American Falls have been seriously deteriorating during the last quarter of a century. The Corps civil works program includes Federal regulatory functions pertaining to the navigable waters of the Great Lakes, collection and dissemination of information on flood conditions, conduct of flood fighting and rescue work, participation in other disaster operations, and surveying and charting the Great Lakes.

The Corps periodically dredges over 100 navigation channels and harbors in the Great Lakes. The practice in many of these areas is to deposit dredged material in deeper waters removed from project channels. Within the last few years, considerable attention has been given to these dredging operations on the premise that they might adversely affect water quality in the Great Lakes. Based upon this presumption, in 1966 the Corps of Engineers and the Federal Water

Pollution Control Administration initiated a joint study to determine the effects of disposing of dredged materials in the lakes and to develop alternative procedures and costs necessary to insure compliance with established water quality standards.

The *U.S. Lake Survey* (USLS), a district office of CE, was created by Congress in 1841 to conduct a hydrographic survey of the northern and northwestern lakes. This work eventually involved a number of related scientific fields such as hydraulics and hydrology, meteorology, geomorphology, and geology. Since 1898, the Lake Survey has been assigned a two-fold mission for the publication of navigation charts of the Great Lakes and the study of all matters affecting their hydraulics and hydrology.

The study of the influences which affect the levels of the lakes was required to determine the extent to which lake levels might be regulated and in what way the depth of the improved navigable channels might best be preserved from reduction due to lowering levels. Systematic records of lake levels and outflow data have been maintained by the Lake Survey since 1860.

The USLS today provides technical support to the Boards of the IJC and to their various Committees and serves other interested agencies and the general public through the collection, correlation, analysis, and publication of physical data on the water resources of the Great Lakes. These data cover water levels and depths, current velocities, river flows, diversions of water, water supplies, over-water and over-land precipitation, temperatures, topography, hydrography, nautical information, crustal movement, geodetic positions, elevations of monumented points, wind velocities, information on ice, and information on related phenomena.

Since 1962, the USLS has also conducted a formalized research program on the Great Lakes in the fields of water motion, shore processes, water characteristics, water quantity, and ice and snow. This program has the objectives of gaining a better understanding of the natural environment and the ability to forecast the effects of natural and artificial modifications. Research in the five fields includes most of the major phenomena and characteristics of the Lakes and their immediate environment as they relate to the missions of the Corps of Engineers in the area.

Office of Naval Research

The *Office of Naval Research* (ONR) was established by organic legislation in 1946. It manages and directs a broad program of scientific research and exploratory development that is designed to make new and improved technological approaches available to the Navy. The ONR encourages, promotes, plans, initiates and coordinates individual programs of naval research. This is done, in part, by ONR's own labora-

tories and in part under contract arrangements with universities, nonprofit institutions, and industrial establishments.

Work on the Great Lakes supported by ONR is carried out as part of the Contract Research Program. Current areas of investigation include studies of waves and wave motion, a biology program studying the plankton ecology of Lake Michigan, perfection of plankton sampling techniques and the application of these to a "ship-of-opportunity" program. A wave and wave motion program includes studies of high-frequency waves, turbulence, whitecapping, kinematics of waves, and a wave and current energy analysis of the near-shore zone.

U.S. Department of Health, Education and Welfare

Water research and investigation is conducted by the Public Health Service of the *Department of Health, Education and Welfare* (HEW) under the authority of the Public Health Service Act. The program can be divided into three sections: Chemical, biological, and radiological. The act also states that water provided by operators of interstate conveyances for drinking and culinary purposes shall either be obtained from watering points approved by the Surgeon General or shall have been subjected to treatment approved by the Surgeon General.

PHS responsibilities also include recreation sanitation, drinking water supply, vector control, solid wastes management, air pollution, radiological health, health ecology, and shellfish sanitation. The Secretary of HEW is a member of the Water Resources Council, and the PHS is active in the preparation of the joint comprehensive plan for the Great Lakes Basin.

The Food and Drug Administration (FDA) has responsibility for surveillance and regulation of pesticide residues found in fish products from the lakes.

Department of Housing and Urban Development

The *Department of Housing and Urban Development* (HUD) was established by organic legislation in 1965, as a combination of several existing agencies. Its main concern is with housing and urban problems, which include assistance for local communities, local public bodies and agencies to finance the cost of acquisition, improvement, and construction of: Sanitation and water facilities; parks, recreation facilities, and open space; storm sewers, and public docks and non-Federal river harbor improvements.

Under Section 701 of the Housing Act of 1954, grants, each in excess of \$50 million, for planning and water and sewer facilities have been made to the eight-State region.

The Secretary of the Department serves as an associate member of the Water Resources Council, and the

Department has membership on the Great Lakes Basin Commission.

U.S. Department of the Interior

The activities of the Department of the Interior are conducted through a number of semiautonomous bureaus and agencies whose planning and related activities in the Great Lakes area are coordinated by a regional coordinator. The Secretary of the Department is a member of the U.S. Water Resources Council. He has been appointed Chairman by the President.

The *Bureau of Commercial Fisheries* (BCF) was established in its present form by the Fish and Wildlife Act of 1956, although its history may be traced to the formation of the U.S. Fish Commission in 1871. The Great Lakes Biological Laboratory was established in Ann Arbor, Mich., by the Bureau of Fisheries in 1927, incorporating on a continuing basis earlier, more scattered activities. In 1959 the Great Lakes and Central Regional Office was formed, including the Great Lakes Biological Laboratory (now the Great Lakes Fishery Laboratory) and other disciplines and functions. Over the years, BCF and its predecessors have been the principal fishery research agencies on the Great Lakes.

The Bureau conducts several programs in the Great Lakes Basin. BCF is under contract to the Great Lakes Fishery Commission to conduct the sea lamprey control program in U.S. waters of the Great Lakes. The biological and limnological programs of the Great Lakes Fishery Laboratory are designed to provide fundamental information of factors which influence changes in the survival and abundance of fish. The Bureau's industrial research program is designed to support and enhance the profitability of the commercial fishing industry. Development of better resource assessment and harvesting methods helps to attain production of the proper combination of species for balanced utilization. Efforts are being made to develop new, high-quality processing techniques and new fishery products in order to expand the market potential for Great Lakes fish species. Other programs consider the economic aspects of production, processing, distributing, and marketing. Some are designed to develop new markets and procedures.

Other BCF programs include administration of the Commercial Fishery Research and Development Act and the Anadromous Fish Act. These give Federal financial assistance to State agencies for programs related to commercial fishery development. The Water Resources Studies Office insures that fishing interests are adequately represented in water resources planning and development programs conducted by Federal agencies, or programs that require a permit from a Federal agency. The Statistical Branch develops statistical data on the commercial fishery.

In conducting these programs BCF operates several research vessels on the Great Lakes. The R/V *Cisco* (60 feet) is used primarily for research on the life history, distribution, abundance and survival of deepwater fish stocks and studies of aquatic environmental conditions. The R/V *Kaho* (65 feet) is used in resource assessment and fishing methods improvement. Both of these vessels are based at Saugatuck, Mich. The R/V *Musky II* (45 feet) operates out of the Sandusky, Ohio Biological Station, and is used for studies of warm water fish stocks of Lake Erie. The R/V *Siscowet* (57 feet) is assigned to the Ashland, Wis. Biological Station, and is used for research on the distribution, abundance, and ecology of lake trout, whitefish, lake herring, and other species in western Lake Superior.

Bureau of Mines

The *Bureau of Mines* (BOM) was established in 1910 by organic legislation. Its programs are designed to conserve and develop mineral resources and to promote safety and healthful working conditions in the mineral industries. Bureau of Mines studies in the Great Lakes region in connection with the preparation of the Great Lakes Basin Commission's joint comprehensive plan include projection of potential mineral industries in each of the lake basins and providing projections of production, employment, water demand, and land use by these industries.

Bureau of Outdoor Recreation

The *Bureau of Outdoor Recreation* (BOR) was established by the Secretary of the Interior on April 2, 1962, as a result of recommendations of the Outdoor Recreation Resources Review Commission. BOR's Organic Act, Public Law 88-29, was signed May 28, 1963. This law authorized BOR to prepare and maintain a nationwide outdoor recreation plan; provide technical assistance to States, their political subdivisions, and private outdoor recreation interests; sponsor, engage in, and assist in outdoor recreation research, and promote coordination of Federal outdoor recreation plans and activities.

BOR's functions were further expanded with the passage of Public Law 88-578, the Land and Water Conservation Fund Act of 1965, and a subsequent amendment, Public Law 90-401. Under this legislation, BOR administers the Land and Water Conservation Fund program which provides financial assistance to the States, and through the States to local public agencies, for the acquisition and development of public outdoor recreation resources. Financial and technical assistance are also provided to the States in the preparation and maintenance of statewide comprehensive outdoor recreation plans. Within the authorization provided by Public Law 88-578, BOR

also coordinates a program of recreation land acquisition by the National Park Service, Forest Service, and Bureau of Sport Fisheries and Wildlife.

BOR provides outdoor recreation planning assistance at Federal water projects in accordance with Public Law 89-72, the Federal Water Projects Recreation Act of 1965. BOR also reviews non-Federal applications for Corps of Engineers permits and Federal Power Commission licenses. Recent legislation directs BOR to coordinate recreation programs with transportation programs, evaluate potential national recreation areas, and conduct studies of trails and wild and scenic rivers for inclusion in national systems.

The Lake Central Regional Office is responsible for performing BOR's functions in the Great Lakes area. This office is currently engaged in the Great Lakes Basin Comprehensive Framework Study, the Great Lakes-Illinois River Basin Study, the International Joint Commission Lake Levels Study, the Grand River Basin Comprehensive Study in Michigan, and the Southeastern Michigan Study. Land acquisition programs for the Indiana Dunes and Pictured Rocks National Lakeshores have been reviewed as part of a 5-year land acquisition program of the National Park Service. Applications for Federal permits and licenses involving waters flowing into the Great Lakes are reviewed to prevent conflicts with public outdoor recreation. The outdoor recreation land acquisition and development programs of all the Great Lakes States are being financially assisted by the Land and Water Conservation Fund program. In conducting the studies and reviews, BOR works closely with the various States, Federal agencies, and other interested parties in an effort to prevent conflicts with ongoing outdoor recreation programs.

Bureau of Sport Fisheries and Wildlife

The *Bureau of Sport Fisheries and Wildlife* (BSFW) has active programs in the Great Lakes involving Federal aid, fish hatcheries, fishery services, management and enforcement, river basin studies, wildlife refuges and wildlife services. Federal aid in fisheries restoration provides for additional sport fishing opportunities through research, management of fish populations, land acquisition and development of fishery access. Research in the Great Lakes and tributaries includes studies on ecology, reproduction, diseases and population dynamics of coho salmon, steelhead trout and alewives; evaluation of lake trout stocking; and wall-eye reproduction, research and fishery surveys.

Under Public Law 89-304 the Bureau seeks to conserve, develop, and extend anadromous and Great Lakes fishery resources. The program cost, shared with the States, includes research, habitat improvement, determining the effects of pollution, program planning, fish facility construction, and stocking. Projects include

construction of coho salmon facilities and design of coho evaluation studies; production, stocking and evaluation of steelhead and brown trout; introduction of coho salmon in Lake Erie; lamprey study; stream improvement, and research on races of walleyes and spawning reefs in Lake Erie.

The Bureau also operates three lake trout hatcheries within the State of Michigan. During fiscal year 1969 these units produced 4.4 million trout, which were marked and released into the Great Lakes as part of the lake trout restoration program. This program will continue at this level until spawning populations are established.

The Division of Management and Enforcement has administrative offices located in each of the Great Lakes States. This Division has the responsibility of enforcing Federal regulations dealing with wildlife and fish, and management of migratory birds in the States included in the basin.

The Division of River Basin Studies (RBS) carries out most of the statutory responsibilities of the Fish and Wildlife Coordination Act. The basic purpose of this activity is to assist in planning the development of the Nation's water resources in a way that protects and develops its fish, wildlife and related values for the benefit of present and future generations. In carrying out its responsibilities the RBS investigates proposed water resource development projects of the Corps of Engineers and small watershed projects proposed under the programs of the Soil Conservation Service. The Division also studies non-Federal projects which require Federal permits or licenses from the Federal Power Commission, the Corps of Engineers, the Forest Service, the Bureau of Land Management and the Atomic Energy Commission.

During the investigations of proposed water resource development projects and river basin plans, the Division works closely, not only with the construction and licensing agencies, but also with the Bureau of Commercial Fisheries and with State fish and game agencies to determine the probable effects of proposed water-use projects on fish and wildlife resources. RBS also develops plans for the protection and improvement of these resources to be included as integral parts of the basin plans, project works or operations.

The RBS is currently involved in several major marine-related activities within the Great Lakes region. It represents the Fish and Wildlife Service on the Shore Property Subcommittee of the International Joint Commission, works on the Great Lakes Comprehensive Study being conducted by the Great Lakes Basin Commission and works on the Great Lakes-Illinois River Basin project, a comprehensive study of water quality directed by the Federal Water Pollution Control Administration. In addition, the Division is also completing its contribution to the Grand River

(Michigan) Comprehensive Basin Study and is participating actively in the Southeastern Michigan Survey Study. The Division also consults with the Corps of Engineers regarding applications for private permits for dredging and filling in navigable waters which flow into the Great Lakes.

The Division of Wildlife Refuges administers many national wildlife refuges in the Great Lakes Basin including: The Huron Islands in Lake Superior; Seney National Wildlife Refuge in Schoolcraft County, Mich.; Michigan Islands including Shoe and Pismire Islands in Lake Michigan and Scarecrow Island in Lake Huron; Wisconsin Islands including Green Bay, Spider and Gravel Island in Lake Michigan; St. Clair Island in Lake St. Clair and Wyandotte Refuge in the Detroit River, Mich.; and Ottawa and Cedar Point National Wildlife Refuges on Lake Erie, Ohio. Congress is considering several of these areas for wilderness status under the Wilderness Act of 1964.

In addition, Shiawassee National Wildlife Refuge is close to Saginaw Bay on Lake Huron and a new proposal is being considered for another waterfowl refuge in Menominee County, Mich., near Lake Michigan.

The National Wildlife Refuge program is designed to protect and preserve wildlife species resident and migratory and to provide for the development and management of the habitat, wildlife, and people to insure the perpetuation of all.

The Bureau's Division of Wildlife Services is conducting a blackbird control investigation program in Ohio and Michigan. The program consists of assessing blackbird depredations on field corn and conducting tests to determine methods to alleviate such damage. The program is being conducted mostly in the counties in the western end of Lake Erie. The counties include Lucas, Ottawa, Sandusky, and Erie in Ohio, and Monroe in Michigan. The headquarters for this program is at Sandusky, Ohio.

Federal Water Pollution Control Administration

The first permanent Federal legislation relative to water pollution control was passed by Congress in 1956 and became Public Law 84-660, the Federal Water Pollution Control Act. It was amended in 1961, 1965, and 1966. The principal activities of the *Federal Water Pollution Control Administration* (FWPCA) relate to water quality management planning, water quality standards, technical assistance, grant programs, interstate enforcement actions, Federal installations and public information.

Section 3(a) of the Federal Water Pollution Control Act, as amended, indicates that the Secretary of the Interior shall, "in cooperation with other Federal agencies, with State water pollution control agencies and interstate agencies, and with the municipalities and industries involved, prepare or develop comprehensive programs for eliminating or reducing the pollution of

interstate waters and tributaries thereof and improving the sanitary conditions of surface and underground waters.”

In connection with the development of comprehensive programs, reports have either been completed or are in process relative to each of the major watersheds of the Great Lakes Basin. The activities of the various work groups of the Great Lakes Basin Framework Study in which the FWPCA is participating provide an important basis for the continued development and revision of comprehensive plans for water pollution control.

Upon the advice of the Secretary of the Interior, based primarily upon determinations of the Federal Water Pollution Control Administration, storage for streamflow regulation to improve water quality may be included in Federal multipurpose reservoirs. Such storage, however, may not be provided as a substitute for adequate local treatment or other methods of controlling wastes at the source.

Section 3(c) of the Federal Water Pollution Control Act, as amended, provides for grants to planning agencies which provide for adequate representation of appropriate State, interstate, local, or (when appropriate) international, interests in a basin or portion thereof. Grants made under this section are to be used to develop a comprehensive pollution control and abatement plan for the area covered.

Under provisions of the Water Quality Act of 1965, water quality standards developed by the eight Great Lakes States have been approved by the Secretary of the Interior. The standards are to be enforced by the States, but the Federal Government will assist in monitoring and pollution surveillance. If the States do not enforce the standards, the Federal Government is empowered to do so under the conditions prescribed in the act. Modifications in previously approved standards may be made as conditions change or as more information becomes available.

The FWPCA technical assistance program provides technical assistance to States, local authorities, and industry upon request through the State water pollution control agencies and to other Federal agencies. The program has responsibility for maintaining water quality surveillance through a monitoring system.

The FWPCA pollution surveillance program provides a mechanism for collection, evaluation, and dissemination of pollution control information and water quality data, particularly as these data relate to the implementation of water quality standards, the establishment of surface-water quality baselines, and planning and management programs. A long-term water quality surveillance system is being established covering intrastate and interstate waters in concert with appropriate State and interstate pollution control agencies and other Federal agencies.

A program of analytical quality control has been initiated to assure a high degree of reliability and comparability in water pollution analyses. This program is being applied in all laboratories of the FWPCA, and it is expected to be instituted in all laboratories providing data to the system.

A computerized storage and retrieval system, STORET, of water quality data collected by the FWPCA and other Interior agencies will be continuously compared with water quality standards stored in the Department of the Interior IBM 360/65 computer. The Great Lakes region has access to the Interior computer through its IBM 1978 terminal in Chicago. This system will assist the FWPCA and the States to fulfill their surveillance responsibility. Arrangements have been made with the Geological Survey to assure that water quality and flow data will be stored for immediate retrieval and evaluation within the FWPCA's computerized STORET system. Also, USGS will assume operating responsibilities as rapidly as possible for the Federal long-term water quality stations. Other matters included in the program are lake currents, wastes from watercraft, disposal of dredged material, and pesticides, and coordination with Canada on solutions to Great Lakes pollution problems.

The grant programs of the Federal Water Pollution Control Administration are of three major types: construction grants, program grants, and research and demonstration grants, as well as basin planning grants, previously described.

The trend of financial assistance for construction grants has been upward each of the three times the act has been amended. Under prescribed conditions, the Federal Government will provide up to 50 percent of the cost of a project and will pay an additional 10 percent of the amount of a grant if the project is certified by a metropolitan or regional planning agency as conforming with the comprehensive plan for a metropolitan area.

Section 7 of the Water Pollution Control Act authorizes an appropriation of \$10 million annually for fiscal years 1968 to 1971 for grants to State and interstate agencies to assist them in meeting the costs of establishing and maintaining adequate pollution control programs. Each State is allotted \$12,000, and the remainder of the funds is distributed on the basis of population, financial need, and the extent of the water pollution problems facing the State.

Section 6 of the Water Pollution Control Act, as amended, authorizes the research and demonstration grants and contracts program. The act calls for establishing field laboratory and research facilities for the conduct of research, investigations, experiments, field demonstration and studies, and training relating to the prevention and control of water pollution. FWPCA research facilities in the Great Lakes region provide a

National Water Quality Laboratory at Duluth, Minn. This laboratory is charged with the responsibility of developing water quality requirements for all fresh water uses in the United States.

Five enforcement conferences have been held to abate pollution of the interstate waters of the Great Lakes and their tributaries. These were called either by the Secretary because pollution from one State endangered the health and welfare of residents of another State or at the request of a Governor of one or more States. Such conferences bring together representatives of Federal and State water pollution control agencies to adopt water quality requirements and a timetable to achieve them. Sources of pollution are identified, remedial recommendations made, and deadlines set. By 1972, all municipal and industrial polluters will be required to have adequate treatment facilities installed. In many instances deadlines are much sooner. More sophisticated control measures—such as the removal of phosphorus from sewage to curb excessive algal growth—are also required in many cases.

The Oil Pollution Act of 1924, as amended, makes unlawful, with some exception, the grossly negligent or willful discharge of oil from vessels into the navigable waters and adjoining shorelines of the United States. The FWPCA was made responsible for the enforcement of this act by the Clean Waters Restoration Act of 1966.

U.S. Geological Survey

The responsibilities of the *U.S. Geological Survey* (USGS) have evolved from its original legislative authority to classify the public lands and examine the geologic structures and mineral resources of the country, to include describing the occurrence, movement, and quality of the water resources of the United States. Through an extensive program of cooperative investigations with the States and a continuing federally supported program, the Survey has collected, analyzed, and interpreted geological and water information for more than 75 years.

The Geological Survey's responsibility in the Great Lakes Basin with respect to water is to describe the hydrology and hydraulics of the physical systems, including their influence on or control by the included biota. Its operational function is somewhat different from that of other governmental agencies in that it directs its activities from the point of view of a resources appraiser. USGS research is aimed at understanding the basic natural laws that affect resources. Its data collection is aimed at inventorying the resources and studying changes. Its goal is to provide the maximum amount of useful information for those who are attempting to manage the resources to provide maximum benefit to the country.

Within the Great Lakes Basin the USGS is operating a data collection network to describe the amount, movement, and quality of water within the basin, and to determine the amounts of water, sediment, and dissolved materials that enter the Great Lakes. Some results of the data collection network operation are furnished to interested users as raw, uninterpreted data on streamflow, water quality, and ground water levels. Other results are incorporated in reports (usually on an areal basis) that interpret water volume and quality, in terms of the general geology and hydrology, in a manner that will help meet the needs of the resources manager. The present program of the Geological Survey in the Great Lakes Basin amounts to about \$800,000 of Federal money annually, matched by an equal amount from State and local governments.

Operating programs of the Survey's Water Resources Division are supported by a broad program of federally funded research. Much of the research seeks a better understanding of the natural processes in the hydrologic cycle, but significant portions of the work are aimed at understanding problems of water pollution and at improving data collection methods. The only direct research on the Great Lakes is a project to apply remote sensing data and theoretical analyses to the study of currents and circulation in Lake Ontario.

The Topographic Division of the Geological Survey has the responsibility for preparing the National Topographic Map Series for the United States and its outlying areas. Topographic maps serve importantly as the framework for the resources and environmental studies which are undertaken in such areas as the Great Lakes Basin. These maps, generally published in standard quadrangle format at scales of 1: 24,000, 1: 62,500, and 1: 250,000, are of prime importance in planning airports, highways, dams, pipelines, transmission lines, industrial plants, and countless other types of construction. They are an essential part of geologic and hydrologic research, of mineral investigations, and of studies on the quantity and quality of water; they greatly facilitate the study and application of flood control, soil conservation, and reforestation.

Over 90 percent of the Great Lakes Basin is presently covered by either the 1: 24,000 or 1: 62,500 scale maps, and new mapping is in progress for an additional 5 percent. About 10 percent of the area is also being revised or resurveyed to 1: 24,000 scale standards. Complete coverage of the 1: 250,000 scale series is published, with updating of several of the maps in progress.

National Park Service

The *National Park Service* (NPS) was established in 1916 to promote and regulate the use of national parks, monuments, and similar reservations in order to "conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (39 Stat. 536; 16 U.S.C. 1).

The Service plans, develops, and administers the natural, historical, and recreational areas which compose the National Park System. These include scenic parks and natural areas; historic sites and buildings; and large recreational areas, including national seashores, lakeshores, and scenic riverways.

Its programs and activities include the Natural and Historic Landmarks Programs which encourage preservation by the private sector; the Historic Preservation Program with its National Register of Historic Places and grants-in-aid to encourage preservation on local, State, and Federal levels; and a new tourism program which seeks to influence the kind and destination of recreational travel. NPS provides technical assistance to other nations, other Federal agencies, and States and their political subdivisions in the development, management, and operation of public park and recreational areas.

National Park Service programs, activities, and areas in all States bordering the Great Lakes, except Minnesota, are the responsibility of the Northeast Regional Director at Philadelphia, Pa. In Minnesota, NPS programs are the responsibility of the Regional Director, Midwest Region, Omaha, Nebr.

The Great Lakes Area Field Office, a suboffice of the Northeast Regional Office in Philadelphia, was opened in July 1967. It handles National Park Service activities in the States of Ohio, Indiana, Illinois, Michigan, and Wisconsin concerned with areas newly authorized by Congress, such as St. Croix and Wolf National Scenic Riverways, Ice Age National Scientific Reserve, and Pictured Rocks and Indiana Dunes National Lakeshores; areas proposed for congressional authorization and addition to the National Park System, such as Sleeping Bear Dunes and Apostle Islands National Lakeshores; and the Great Lakes Basin Framework Study for which the Office provides the coordinator for the study area on environmental quality.

Office of Water Resources Research

The *Office of Water Resources Research* (OWRR) was established by organic legislation. Its mission as related to research is to assist in assuring that the Nation at all times has a water supply sufficient in quantity and quality to meet the requirements of an expand-

ing population. OWRR's basic function is to administer the Water Resources Research Act of 1964, as amended, by stimulating, sponsoring, and providing for research and training in the fields of water and those resources affecting water. Financial support is provided to State water resources research institutes and centers by outright annual allotments and by matching grants and to qualified individuals, private firms, educational institutions, and public agencies by grants, contractual, matching or other arrangements. The OWRR has been assigned the responsibility for coordinating the water resources science information activity. This includes supporting special user services such as the Water Resources Research Catalog and the development of an information base.

The water resources research and training program administered by OWRR is broad in scope. Ongoing or recent OWRR supported studies in the Great Lakes region include research and investigations on the open water distribution and abundance of net plankton as an index of the eutrophication in Lake Superior; circulation of Lake Superior; radar measurement of precipitation on Lake Michigan; watershed analysis relating to eutrophication of Lake Michigan; systems analysis of the western basin of Lake Erie; public investment criteria for water-oriented recreation in the Lake Erie Basin; ecologic impact of the interactions among microorganisms and aquatic contaminants in Lake Erie; trace element concentration in Lake Huron and its principal tributaries; channel hydraulics and hydrologic systems analysis of the Great Lakes. Water problems of metropolitan areas of the Great Lakes are also receiving attention. A current study by the University of Michigan is directed to urban water politics and decision making in the Detroit metropolitan area.

The Council on Economic Growth, Technology, and Public Policy of the Committee on Institutional Cooperation (CIC) recently completed its study, at the request of OWRR, on research needs in the Great Lakes area. This is further explained in the résumé of the CIC.

U.S. Department of Transportation

The Secretary of Transportation is a member of the U.S. Water Resources Council.

U.S. Coast Guard

The incorporation of the *U.S. Coast Guard* (USCG) into the Department of Transportation in 1967 focused new attention on the Coast Guard's role relative to the safety of shipping, life, and property on the Great Lakes. For a number of years the Coast Guard has provided icebreaking services and contributed to an interagency effort toward improving ice forecasting. In the spring of 1968, one of the Coast Guard's polar icebreakers was deployed to the Great Lakes. The first

U.S. vessel through the locks, she assisted significantly in an early opening of the Port of Buffalo.

Cooperative efforts continue with the U.S. Weather Bureau and the U.S. Lake Survey in studies of freeze-up and thaw, water temperature and waves. The USCG is represented by oceanographic and merchant marine technical personnel on a professional task force to collect and collate data to establish strength standards for large bulk ore carrying ships.

The USCG cutters *Woodrush*, *Woodbine*, *Naugatuck*, and *Acacia* are committed periodically to the support of Great Lakes studies by such groups as the University of Michigan's Great Lakes Research Division, Carnegie Institute's Division of Terrestrial Magnetism, U.S. Geological Survey, U.S. Lake Survey, and the U.S. Weather Bureau. Various Coast Guard shore stations continually contribute to certain of these programs as data collection points. As the small-boat population expands, much of these data, originally intended to support studies relating to commercial shipping, are being utilized to provide better and more meaningful forecasts to the recreational boating public.

St. Lawrence Seaway Development Corporation

The *St. Lawrence Seaway Development Corporation* was created by Congress in 1954. The Seaway itself, an American-Canadian venture, became a reality on June 26, 1959, after an expenditure of \$480 million. The American corporate structure is headed by an Administrator with an Advisory Board appointed by the President. This Board meets quarterly as a consultant group to review the general policies of the Corporation. Policy decisions are reported by the Administrator to the Secretary of Transportation.

The purposes of the Corporation are to construct, operate, and maintain deep-water navigation works in the American sector in coordination with the Seaway Authority of Canada, establish operating agreements, calculate a toll base consistent with a 50-year payout period, and to serve as a stimulant to Great Lakes economy. Currently, the Corporation is primarily engaged in major lock rehabilitation work, studies for extension of the navigation season, and the construction of new locks in conjunction with the U.S. Army Corps of Engineers.

Atomic Energy Commission

The *Atomic Energy Commission* (AEC) was established by organic legislation and is composed of five members, one of whom is designated as chairman and all of whom are appointed by the President. It has responsibility to protect the health and safety of the public from nuclear activities and to regulate and control the use of special nuclear materials and sources and byproducts of these materials.

The AEC is conducting several research and de-

velopment activities which involve the Great Lakes region. Studies are devoted to investigating the nutrients and biologically important minerals in Lake Michigan, and determining their sources and their effects on phytoplankton populations. Additional pertinent research which is being conducted in the general Great Lakes region includes basic investigations of nutrient cycling and productivity of dystrophic lake-bog systems, studies of the composition and biological role of dissolved organic matter in lake systems, and investigation of the effects of limnological factors on the uptake and cycling of radioactive material. A program of peripheral interest involves a digital simulation program developed for the investigation and protection of Columbia River water quality. This project appears to have some application to the Great Lakes, and a modest effort to test the applicability, using Lake Michigan data, will be undertaken in the near future.

Federal Power Commission

The *Federal Power Commission* (FPC) was established by Congress in 1920 to administer the Federal Water Power Act, now Part I of the Federal Power Act. The Commission functions as an independent agency and consists of five Commissioners, appointed by the President with the advice and consent of the Senate, serving 5-year terms.

Under the provisions of the Federal Power Act, the various Flood Control and River and Harbor acts, the Water Resources Planning Act, and related acts, the FPC has statutory responsibilities relative to the planning, construction, and operation of water resources projects, particularly with regard to the development of power. The FPC is authorized to make investigations concerning the utilization of the water resources of any region to be developed and to cooperate in such investigations with agencies of Federal and State Governments.

The FPC cooperates with Federal agencies and with Federal-State entities in river basin investigations by making studies and furnishing information on such matters as the potentialities for power development, the market for the potential power, the value of the power, and cooling water needs for steam-electric plants. It makes recommendations to the Secretary of the Army with regard to the installation of penstocks or similar facilities adapted to the development of power at projects constructed by the Department of the Army.

The FPC issues preliminary permits and licenses for definite terms not exceeding 50 years to individuals, corporations, States, and municipalities for the investigation, planning, construction, and operation of hydroelectric projects on navigable waterways or on any stream over which the Congress has jurisdiction

where the project affects interstate commerce, or on public lands and reservations of the United States. The Federal Power Act requires that each project to be licensed be best adapted to a comprehensive plan of development for all beneficial public uses, including recreation. The Commission normally imposes a number of standard and special conditions in licenses to ensure optimum development of the project site and conservation of resources.

The principal hydroelectric projects operating under FPC licenses in the Great Lakes Basin are those constructed by the Power Authority of the State of New York on the Niagara and St. Lawrence Rivers. A number of smaller developments on Great Lakes tributaries also operates under FPC licenses.

The Chairman of the FPC is a member of the Water Resources Council. The FPC is represented on the Great Lakes Basin Commission.

National Council on Marine Resources and Engineering Development

Committee on Multiple Use of the Coastal Zone

Great Lakes Panel

The Marine Resources and Engineering Development Act of 1966 (Public Law 89-454) established the *National Council on Marine Resources and Engineering Development*, and included the Great Lakes within its purview. To discharge its responsibility for this and other parts of the coastal zone, the Council set up the Committee on Multiple Use of the Coastal Zone in 1967, and in 1968, this Committee created the *Great Lakes Panel*. Membership on the Panel consisted of representatives from the following Federal agencies: National Science Foundation; Smithsonian Institution; Atomic Energy Commission; Corp of Engineers, U.S. Army; and the Departments of Commerce; Health, Education and Welfare; Interior; and State.

The Panel attempted to understand better the Great Lakes and the problems besetting them. In particular, it concerned itself with the problems of water quality and quantity; the increasing multiple uses of the lakes' resources and the resulting conflicts; the nature and relationship of institutions in the United States and Canada having responsibilities for planning and managing the lakes; the research and development needed to find and implement solutions to growing problems of international dimensions, and, finally, to recommend to its parent Committee and the Council courses of action which the Panel thought necessary or desirable.

The Panel held a series of meetings and heard testimony from a wide range of experts from the United States and Canada. It sponsored a 2-day symposium at the University of Michigan to inquire into research problems and needs on both sides of the border.

The Panel authorized a final report on its finding and recommendations, and submitted it to the Committee on Multiple Use of the Coastal Zone in March 1969. The final report of the Committee's Executive Secretary to the Council covered a broad spectrum of matters relating to the coastal zone, and included a substantial section on the Great Lakes.

National Science Foundation

Created by act of Congress in 1950, the *National Science Foundation* (NSF) has a major responsibility to encourage basic scientific research in the Nation's colleges and universities. A number of research projects sponsored by NSF in the Great Lakes area are of interest and concern to the overall problem of increasing the pool of fundamental knowledge concerning the Great Lakes Basin.

Oceanographic aspects of the Great Lakes are handled by two different branches of NSF. Biological oceanography is handled in the Section of Environmental and Systematic Biology in the Division of Biological and Medical Sciences. Physical, geological, and chemical oceanography are handled in the Division of Environmental Sciences. In many cases, where proposed investigation is interdisciplinary, joint support is provided by the two divisions.

Smithsonian Institution

The Smithsonian Act of 1846 established the *Smithsonian Institution* "for the increase and diffusion of knowledge among men." Chartered by the Congress and privately endowed, the Smithsonian has both Government and private operations. Because of its extensive collections of marine rocks, sediments, and biological organisms, the Smithsonian has emphasized research on these objects and fieldwork in specimen related science. Nearly 70 scientists from six Bureaus carry on field and laboratory activities in marine science, including the Great Lakes.

The Smithsonian formally joined the Federal oceanography program in 1962, and its principal contribution to this effort has been the handling and identification of marine organisms and sediments. Several scientists have incidental interests in Great Lakes organisms and sediments; however, none are involved full time. The Science Information Exchange receives, organizes, and disseminates information about research in progress in the life and physical sciences, including that in the marine sciences.

Water Resources Council

The *Water Resources Council* (WRC) was established by the Water Resources Planning Act of 1965 (Public Law 89-90) and consists of those departments and independent agencies in the Federal Government

that have the major responsibility for water resources programs throughout the Nation. The Council presently consists of the following members: Secretary of Agriculture, Secretary of the Army, Secretary of Health, Education and Welfare, Secretary of the Interior, Secretary of Transportation, and Chairman of the Federal Power Commission. The Secretaries of the Departments of Housing and Urban Development and Commerce are associate members, and the Department of Justice and the Bureau of the Budget furnish observers. The Chairman of the Council, designated by the President, is presently the Secretary of the Interior.

The functions of the Council include: Preparation of biennial national assessments of water supplies; appraisals of Federal policies and programs; studies of the adequacy of administrative and statutory means for coordination of Federal policies and programs; establishment of principles, standards and procedures for Federal planning; coordination of schedules, budgets and programs; recommendations regarding establishment and operations of river basin commissions; review of comprehensive river basin plans with special regard to the efficacy of these plans in achieving optimum use of the resources, the effects of the plans on other related programs and resources and the contribution of such plans to obtaining national economic and social goals; recommendations to the President concerning such plans; and assistance to States in increasing water resource planning capabilities.

UNITED STATES—STATES

Great Lakes Basin Commission

The *Great Lakes Basin Commission* (GLBC) was created in 1967 by Executive Order of the President, pursuant to the Water Resources Planning Act. Requests for this action—under title II of the Act—were initiated by the Governors of Indiana, Michigan, Minnesota, Ohio, and Wisconsin, with the concurrence of the Governors of Illinois, New York, and Pennsylvania, and the Water Resources Council. The Commission submits its reports to the Congress through the Water Resources Council and the President.

Commission members represent the eight States bordering the Great Lakes, nine Federal agencies, and the Great Lakes Commission. State representatives are the heads of the resource departments, as appointed by the Governors. Representatives of the Federal agencies are generally the regional supervisors, appointed by the Secretary of each Department having a substantial activity concerned with the water resources of the Great Lakes Basin. The following Departments are represented: Agriculture; Army, Commerce; Health, Education and Welfare, Housing and Urban Develop-

ment; Interior; Justice; and Transportation; and the Federal Power Commission. The Chairman of the GLBC is appointed by the President.

The duties of the Commission are to (1) serve as the principal coordinating agency for Federal, State, interstate, local, and nongovernmental plans for the development of water and related land resources in the region; (2) prepare and keep up to date a comprehensive, coordinated, joint plan for Federal, State, interstate, local, and nongovernmental development of water and related resources, which shall include an evaluation of all reasonable alternative means of achieving optimum development of water and related land resources of the basin, and it may be prepared in stages, including recommendations with respect to individual projects; (3) recommend long-range schedules of priorities for the collection and analysis of basic data and for investigation, planning and construction of projects; (4) foster and undertake such studies of water and related land resources problems in its area, river basin, or group of river basins, as are necessary in the preparation of the plan described in clause (2) above; and (5) engage in such activities and make such studies and investigations as are necessary and desirable in (a) carrying out the policy of Congress to encourage the conservation, development, and utilization of water and related land resources on a comprehensive and coordinated basis by the Federal Government, States, localities, and private enterprise with the cooperation of all affected Federal agencies, States, local governments, and others concerned, and (b) in accomplishing the purposes set forth in items (1) through (4) above.

This arrangement by the States and the U.S. Water Resources Council for the joint, collaborative use of Federal and State authorities in water resource planning provides a new dimension for action on a host of pressing water problems in the Great Lakes area. With new concern for the quality of the total environment, a multitude of problems will be dealt with together: inadequate municipal, agricultural and industrial water supplies; polluted lakes and rivers; blighted waterfronts; floods; shortages of water-based recreational opportunities; ecological imbalances within certain lakes; improper management of flood plain areas; inadequate navigation facilities; uncontrolled and economically destructive extremes in lake levels; severe shoreline, streambank and watershed erosion and sediment production; conflicting uses of the lakeshores; inadequate management of wildlife resources; overlapping and conflicting institutional authorities and arrangements; and the need to preserve some rivers, in part or in whole, in their natural or

enhanced condition for scenic beauty and recreational use.

At the present time, the Commission is conducting a comprehensive, coordinated framework study for the basin to (1) provide economic projections of development; (2) translate economic projections into demands for water and related land resources; (3) provide hydrologic projections of water availability both as to quantity and quality of surface and ground waters; (4) provide projection of related land resource availability and demand, so as to outline the general character of projected water and related land resource problems; and (5) outline the general approaches that appear most appropriate for the solution of these problems, as well as an evaluation of the impact of all reasonable alternative solutions. Additional, more detailed studies will be undertaken in the near future to develop the comprehensive, coordinated, joint plan for the basin.

Upper Great Lakes Regional Commission

Through the Public Works and Economic Development Act of 1965 and in response to requests from the Governors of Michigan, Minnesota, and Wisconsin, the Secretary of Commerce designated the Upper Great Lakes area an Economic Development Region in 1965. This paved the way for the formal organization of the *Upper Great Lakes Regional Commission* in 1967. Creation of the Commission provided the opportunity to make a multistate approach to the unhealthy economic situation in the region. Membership of the Commission reflects the Federal-State partnership. The Commission is composed of one Federal member appointed by the President (the Federal Co-chairman) and one member from each participating State in the development region (the Governor, or his designee, or such other person as may be provided by the law of the State which he represents).

The Commission was given the task of identifying economic problems and potentials of the region and of recommending public investment programs to stimulate the lagging economy of the region. Completion of tourism and employment studies have pointed up the economic potentialities of the Great Lakes and other lakes in the region. Methods are currently being sought to curb lake pollution in order to enhance their recreational and occupational potentials.

INTERSTATE

Great Lakes Commission

The *Great Lakes Commission* (GLC) was established in 1955 under the Great Lakes Basin Compact, an interstate agreement designating the Commission as a joint State instrumentality on Great Lakes water resource developments, programs, and problems. Congressional consent was granted by Public Law 90-419 in 1968. The Commission is composed of from three to five representatives from each of the eight member States bordering the Great Lakes. It meets at least twice annually and maintains five standing committees, special committees as required, and a staff in Ann Arbor, Mich. Three principal services provided to the member States are:

(1) A clearinghouse for information on important developments on the Great Lakes through special studies, bulletins, and reports to assist in the use, protection, and further development of these water resources. The Commission's principal publication on Great Lakes aquatic science, "Great Lakes Research Checklist," is complemented by the "Great Lakes News Letter" summarizing development activities.

(2) A recognized and continuing council, under State direction and control, for joint consideration of common and regional problems in the Great Lakes. The GLC is financially supported at a level of \$64,000 per year, each State contributing equally.

(3) Coordination of State views, plans, recommendations, and programs and policies at all levels of government which the States believe to be in the public interest. The GLC conducts general interest surveys on subjects such as sport fishing regulations and transportation and trade on the lakes and St. Lawrence Seaway.

Major current activities include:

(1) Promotion of the economic development of the region through judicious and increased use of the Great Lakes-St. Lawrence Seaway waterway system.

(2) Maintaining and enhancing the ecology of the region through studious application of laws, statutes, regulations, rules, practices and procedures pertaining to: (a) Use of persistent pesticides, (b) overabundance of alewives in Lake Michigan, (c) eradication of the sea lamprey, (d) pollution control and abatement, (e) water levels of the Great Lakes, and (f) comprehensive planning and development of the water and related land resources of the Great Lakes region.

States and Universities

Committee on Institutional Cooperation

The *Committee on Institutional Cooperation* (CIC) was established in 1958 by the presidents of the Big Ten universities and the University of Chicago as a means of expanding opportunities in certain highly specialized areas of instruction, research, and public service.

The Great Lakes have been targets for a number of studies by the CIC. Research activities include an analysis of Lake Michigan's glacial shore and a biometeorological attack on water pollution. Planning activities have included symposia on the eutrophication of natural waters. At the request of OWRR, the CIC's Council on Economic Growth, Technology, and Public Policy conducted a study on research needs in the Great Lakes area. This study was entitled "Analysis of Water and Water-Related Research Requirements in the Great Lakes Region" and directed attention to the need for a systems analysis model of the Great Lakes.

ILLINOIS

While the land area of Illinois draining into the Great Lakes is quite small, the basin is important to the State. The concentration and size of the population within Illinois drawing upon Lake Michigan for its water supply is the largest in the State and the entire basin. The only major diversion from the lakes occurs at Chicago which serves to divert the municipal and industrial sewage effluent away from Chicago's source of water supply. The lake is a source of industrial and recreational opportunities, as well as an aesthetic asset to the State.

Department of Conservation

Division of Fisheries

The *Division of Fisheries* of the *Department of Conservation* is responsible for the assessment of the sport and commercial fishery in the Illinois waters of Lake Michigan. This includes a general survey of lake trout restoration and assessment of the coho fishery in order to determine the presence and abundance of these species. In the spring of 1969, the division released 10,000 coho smolts in the Chicago area. These fish were marked and will be checked for returns in the fall of 1969 and 1970.

Department of Registration and Education

Water Survey Division

The *Water Survey Division* of the *Department of Registration and Education* was established through legislative reorganization in 1917. This division, in cooperating with other State agencies, investigates and studies the natural resources of the State, so that Illinois' available water resources may be better known. The division considers and decides all matters pertaining to water and water resources and allied investigational and scientific research, and cooperates with the University of Illinois in the use of scientific staff and equipment. It also cooperates with the various departments in research, investigational, and scientific work.

The Water Survey Division carries on independent as well as cooperative studies with the University of Illinois and the Committee on Institutional Cooperation relating to systems analysis of the Great Lakes. Also included is a study of long-term changes in chemical elements as an index of changes in water quality.

Sanitary Water Board and Department of Public Works and Buildings

The Illinois Rivers and Lakes Act of 1911, as amended, empowers the *Sanitary Water Board* and the *Department of Public Works and Buildings* to exercise joint jurisdiction for the preservation and utilization of Lake Michigan waters. Though they are separate, cooperating agencies, the Board's administrative offices are in the Department of Public Health, and it obtains technical support from that department's Division of Sanitary Engineering. Approval of both of these agencies is required prior to the initiation of any dumping or discharge into Lake Michigan. The Sanitary Water Board consists of the Directors of the Departments of Health, Agriculture, Conservation, and Public Works and Buildings (Division of Waterways), the Secretary of the Municipal League and a representative of industry. All are appointed by the Governor. The chairman is elected by the board. In addition to its permissive powers, the board has been empowered to conduct water quality and lake-bed surveys to evaluate the ecology and quality of water in Lake Michigan. The Division of Waterways of the Department of Public Works and Buildings has been investigating the processes of shore and beach erosion along the Illinois shore

of Lake Michigan since 1950. These are continuing studies supported by data collected at selected sites. The Sanitary Water Board has established and enforces water quality standards for the Illinois portion of Lake Michigan.

Illinois Institute of Technology

The Department of Biology at the *Illinois Institute of Technology* has been conducting studies on the yeast found in the Great Lakes and their drainages. The purpose of the current investigation in progress is to isolate and identify, quantitatively, the yeast species present at selected locations in the streams in the Calumet area. The sites represent industrial pollution, domestic pollution, and relatively nonpolluted water. The species isolated will be correlated statistically with chemical, physical, and other biological pollution indicators in order to determine, if possible, some relationships between yeasts and their polluted water environment. Another investigation in progress since 1967 is a survey of yeasts present in Lake Superior and some of the streams entering it from both the north and the south.

Northern Illinois University

Great Lakes research being conducted at *Northern Illinois University* encompasses floristic, taxonomic and ecological studies of the phytoplankton of Lake Huron. Specimens have been collected during synoptic surveys conducted by the Great Lakes Research Division at the University of Michigan.

University of Illinois

The Water Resources Center of the *University of Illinois* was established as part of the graduate college by the Board of Trustees in 1963. Following the enactment of the Water Resources Research Act of 1964, the center was designated as the water resources research institute for Illinois by the Governor. The center now administers title I of the act in Illinois as well as a State-supported program of water resources research and education. The center's primary responsibility is the sponsoring and administration of water resources research. Programs of this nature on the Great Lakes include: "Feasibility of Evaluation of Benefits from Improved Great Lakes Water Quality" for the Corps of Engineers, and "Study of the Hydrology for Models of the Great Lakes" with the Department of Civil Engineering and the Illinois State Water Survey. The center is interested in continuing research in the Great Lakes.

INDIANA

Portions of Indiana lie in the drainage basins of Lakes Erie and Michigan and comprise approximately 5 percent of each of these lakes' basins. The Lake

Michigan region plays a vital role in the economy of the State. This is a highly industrialized area that accounted for 11.5 percent of the Nation's total of steel rolling and finishing in 1963. The lake also provides commercial and sport fishing to the State and offers unique recreational activities. These have been further enhanced by the authorization of the Indiana Dunes National Lakeshore.

Department of Natural Resources

The *Department of Natural Resources* was established in 1965 to bring together the functions and responsibilities of four former State agencies: the Department of Conservation, the Indiana Flood Control and Water Resources Commission, the Recreation Council, and the State Soil Conservation Committee. The department consists of a Natural Resource Commission, a director, and two deputy directors. The commission consists of 12 members, of whom six are ex officio members.

The *Division of Forestry* has primary responsibility for the protection, management, and utilization of the forest resources of the State including the administration of Public Law 566 Small Watershed Projects.

The *Division of Fish and Game* has primary responsibility to supervise the stocking and harvest of fish and game resources in the State and to manage these resources for the greatest good of the State. Current fishery research involves investigations of reproductive success, year class distribution, growth rate, condition, temperature preference, seasonal movements, habitat preference, interspecific relationships of salmonids, perch, and alewives, the food habits of these species and the relation of these habits to the distribution and abundance of available food organisms.

The functions of the *Division of Parks and Memorials* are to acquire, develop, and maintain public recreation areas and places of historical interest for the people of the State.

The *Division of Outdoor Recreation* acts jointly when advisable with other State agencies and local communities in order to carry out the State's objectives and responsibilities in the field of recreation.

The *Division of Engineering* provides planning, architectural and engineering services to the other Divisions.

The *Geological Survey* has the responsibility to locate and describe precisely the State's mineral resources.

The *Division of Water* has primary responsibility for the planning, regulatory, construction, and administrative functions of the water resources of the State. Division responsibilities include studies and investigations needed to develop projects wherein State participation is warranted in order to obtain multiple purpose development of specific small watershed and reservoir

projects, to make long-range studies of river basins, to develop overall solutions to regional flood control and water resources problems, and to establish a backlog of projects for future development.

The *State Soil and Water Conservation Committee* of the department is authorized by chapter 171, Indiana Acts of 1965, and is composed of six members appointed by the Governor: Four farmer members, the director of the department and the Lieutenant Governor. The committee organizes, guides and supports local Soil and Water Conservation Districts and sees that they operate according to the law.

State Board of Health

The *State Board of Health* has supervision of the health and life of the citizens of the State and possesses all powers necessary to fulfill the duties prescribed in the statutes and to bring action in the courts for the enforcement of health laws and health rules.

Plans for public water supplies and sewage works projects and improvements thereto must be reviewed and approved prior to construction.

The board has authority to supervise all public water supply systems and require submission of monthly operating reports and drinking water samples as determined by the Board of Health.

The board's staff is organized administratively into six bureaus and 30 divisions. Functions relating to water supply and pollution control are handled through the Divisions of Sanitary Engineering and Water Pollution Control, under the Bureau of Engineering. These divisions furnish technical staff and assistance to the Stream Pollution Control Board in matters relating to water pollution control.

Stream Pollution Control Board

The *Stream Pollution Control Board*, created by legislation in 1943, is the agency empowered to control and prevent pollution of waters in Indiana. The board represents the State in the Federal water pollution control program, approves plans and specifications for pollution abatement facilities, assigns specifications for pollution abatement facilities, assigns priorities to municipalities for Federal aid under the Sewage Works Grants Program, and adopts water quality standards and plans for implementing such standards. The board is responsible for implementing the recommendations of the Conferences on Lakes Michigan and Erie and in implementing a time-phased plan for the completion of required pollution abatement facilities in basins tributary to the Great Lakes, as well as the rest of the State.

Purdue University

The Water Resources Research Center was established as a part of the *Purdue University Natural Re-*

sources Institute in 1964. This was the first constituent center within the institute, and was established to fulfill the requirements imposed by the Water Resources Research Act of 1964. The center is composed of all university staff members and graduate students working with and interested in water resources research and teaching. The center has participated in the regional study supported by OWRR concerning Great Lakes Systems Models, and several conferences have been held in anticipation of regional research in the Great Lakes Basin. These have been coordinated by the Committee on Institutional Cooperation in conjunction with representatives from the National Water Quality Laboratory, Duluth, Minn., and the Great Lakes Basin Commission.

MICHIGAN

Consisting of two peninsulas surrounded by Lakes Superior, Michigan, Huron and Erie, Michigan calls itself the "Great Lake State." All but 25 square miles of the State lie within the Great Lakes drainage basin. The lakes have played an important part in the development of Michigan, and the State has taken a leading role in management of the lakes.

Department of Agriculture

The *State Soil Conservation Committee* in the *Department of Agriculture* is responsible for two broad program areas concerned with the management of surface water. It is charged with administering the 84 soil conservation districts in 82 Michigan counties. Over 50,000 landowners are cooperators. One main objective of these districts is erosion control which would reduce water sediment pollution.

A second major responsibility of the committee is to act for the Governor's office in processing community requests for Federal watershed assistance under congressional act (Public Law 566, 83rd Cong.) The committee has already received and taken some action on 59 applications for this assistance.

Department of Natural Resources

The *Department of Natural Resources* is charged with protecting the natural resources of the State. Michigan law provides authority for the conduct of certain activities related to pollution abatement by and under the supervision of the director of the department. The basic act creating the department confers a broad grant of authority to ". . . prevent and guard against the pollution of lakes and streams within the State . . ." The department has maintained active patrol of oilfields and has required the application of measures for the conservation of brine and prevention of pollution since 1939. The Director also serves as a member of the Water Resources Commission.

Fish Division

The Department of Natural Resources' *Fish Division* is charged with the responsibilities of water inventories, hatchery production and planting, lake and stream improvements, and biological and physical profiles surveying to provide better opportunities and returns for the State's fishermen.

Game Division

Over the years, the *Game Division* has built nearly 50 major waterfowl floodings in Michigan. These cover about 20,000 acres. An additional 400 small impoundments with a total water surface area of 3,000 acres are also managed throughout the State. Water level control structures, dikes, and other works are all constructed to provide the needed waterfowl habitat.

Geological Survey

The *Geological Survey* works with State and Federal departments to locate and develop suitable supplies of water for public institutions, parks, agencies, municipalities, industries, irrigation projects, and individual landowners. Further, the division issues permits for drilling oil and gas wells; supervises the locating, drilling, producing and plugging of these wells; and aids in the protection of property and surface and underground fresh waters from oilfield wastes.

Recreation Resource Planning Division

The water related functions of the *Recreation Resource Planning Division* revolve around its responsibility for long-range planning for outdoor recreation for both the department and the State and for administration of the Federal Land and Water Conservation Fund program designed to help finance State and local outdoor recreation projects. The division is also inventorying Michigan's lake and stream frontage to gauge the recreational potential of lands bordering waters.

Water Resources Commission and Bureau of Water Management

The *Water Resources Commission* (WRC) is the pollution control arm of the State. It is under legislative mandate to "... protect and conserve the water resources of the state, to have control over the pollution of any waters of the state and the Great Lakes, with power to make rules and regulations governing the same ... to prohibit the pollution of any waters of the state and the Great Lakes." The commission is designated as the State agency to cooperate and negotiate with other governments and agencies concerning the water resources of Michigan.

By legislative act, the Water Resources Commission is within the structure of the Department of Natural Resources. However, the Commission's statutory pow-

ers of rulemaking and adjudication, including the prescription of regulations and standards, are exercised independently of the director of the department.

The seven members of the commission include the directors of the Departments of Natural Resources, Public Health, Agriculture, and State Highways. The other three members are appointed by the Governor, with approval of the State Senate, as representatives of municipal, industrial, and conservation interests.

The *Bureau of Water Management* constitutes the technical and clerical staff of the commission. It was formed by the reorganization of May 1969 which consolidated the water management responsibilities of the department in one high-level unit. Under the reorganization, the bureau's staff duties will be expanded and rearranged into three divisions covering water quality control, hydrological studies, and water development services for local units of government. Such water-oriented activities as submerged lands management, base engineering, and oil pollution control, now scattered throughout the Department of Natural Resources, will be transferred into these new divisions.

Controlling pollution of Michigan's lakes, streams, drains, and underground waters is the major responsibility of the Water Resources Commission and its bureau staff. The staff also advises the public on water laws, water conservation, water uses, stream flow, dams, and other water resource matters. The bureau reviews and assigns priorities to applications from municipalities for Federal aid in constructing pollution control facilities. It reviews applications and issues permits for water use in low-grade ore beneficiation. In addition, the bureau provides advisory and technical assistance to resort and cottage owners.

The commission headquarters and most of the bureau staff are located at Lansing. In addition, the bureau has five districts headquartered at Point Mouillee, Lansing, Grand Rapids, Cadillac, and Escanaba.

Waterways Commission

The *Waterways Commission* was created by Act 330 of the Public Acts of 1947. It is vested with the responsibility of representing the State of Michigan on all matters pertaining to navigation involving the Federal Government. The commission has also been granted authority to undertake the actual construction of recreational boating facilities on the waters of the State, and it has responsibility for public access sites.

Department of Public Health

The *Department of Public Health* exercises supervisory control over all public sewerage systems in the State. No public sewerage system may be built or altered without approval of the director. The department reviews and approves or rejects plans submitted for new municipal systems or alterations to existing

systems. It issues or withholds issuance of construction permits for sewers and sewage treatment plants. It exercises supervisory control over operations of wastewater treatment plants at municipalities, institutions, trailer parks, schools, and hospitals to ensure effective performance. It trains and licenses operators of wastewater treatment plants. When appropriate, the department refers cases to the Water Resources Commission for pollution abatement action. The director of the department also serves as a member of the Water Resources Commission.

Department of State Highways

The water interests of the *Department of State Highways* center largely upon phases of the State's water resource program other than pollution control. However, the Highway Commission, through its director, is relied upon to correct or prevent misuse of the many thousands of miles of department-owned highway drains arising from connections thereto of septic tank drainage, sewage or industrial wastes. The director of the Department of State Highways also serves as a member of the Water Resources Commission.

Michigan State University

The original establishment of the Institute for Water Research was formalized by the *Michigan State University* board of trustees in 1961. As a result of the Water Resources Research Act, the mission of the institute broadened to include funding at other universities as part of the water research program. Research has been supported at the University of Michigan, Wayne State University, Central Michigan University, Michigan Technological University, and Michigan State University. Activities of the institute include the funding of research in engineering, economic, biological, sociological, and systems analysis as related to water resources. Through both allotment grants and outside sponsorship, a considerable amount of research is being carried out on the physical, chemical, and biological aspects of water quality of streams entering Lake Michigan.

Northern Michigan University

Northern Michigan University is vitally interested in the Great Lakes. This has prompted a number of studies related to marine and land resources of the Great Lakes area. The Department of Biology is conducting a study of the changes in physiochemical conditions and biota of Lake Superior in the area of Marquette harbor to determine whether the growth in industry and population has accelerated the eutrophication process. The Department of Geography, with the cooperation of the U.S. Lake Survey vessel *Shene-*

hon, is involved in a continuing study of Lake Superior currents.

University of Michigan

Great Lakes Research Division

The Board of Regents of the *University of Michigan* established a Great Lakes Research Institute in 1945. Its objectives were stimulation, promotion and coordination of research on the Great Lakes, as well as the implementation of the University's relevant teaching and research programs. In 1960, the institute was reorganized as the *Great Lakes Research Division* (GLRD) of the Institute of Science and Technology at the University of Michigan.

Two well-equipped research vessels are owned and operated by the division: The 114-foot *Inland Seas* and the 50-foot *Mysis*. Institutions conducting basic research or training programs on the Great Lakes may make arrangements with the division for use of ship time. Research thus far has been confined to selected problems within Lakes Michigan, Huron, and Superior.

The following problem areas encompass the division's present activities and research interests in the Great Lakes: Water budget, water quality, translocation and circulation, air-water interface phenomena, effects of the lakes on regional meteorological conditions, ice cover, chronology of the lakes, erosion and deposition, nature of the lake basins, biological productivity and resources, and engineering and development.

The GLRD is convinced that a successful plan of attack on the increasing problems involved in shipping, water supply, sanitation, recreation, and biological resources necessitates a background of basic scientific information.

MINNESOTA

Minnesota's location at the head of deep-draft navigation in the Great Lakes has promoted her use of the lakes as an outlet for shipment of her iron ores and grain. Duluth is one of the largest and busiest ports on Lake Superior. The State encompasses 189 miles of the Lake Superior shoreline. About 9 percent of Minnesota's land area lies in the drainage basin. This area includes the St. Louis River, the largest U.S. tributary to Lake Superior. The recreational and scenic values of the northern shore of Lake Superior will require additional small-boat harbors and points of lake access for optimum development.

Department of Conservation

The *Department of Conservation* is responsible for public land and water management and protection. It consists of five divisions: Lands and Forestry; Waters,

Soil and Minerals; Parks and Recreation; Game and Fish, and Enforcement and Field Service. Each division is headed by a director appointed by the Commissioner of Conservation. Attached to the commissioner's office are four bureaus which serve the entire department. They are: (1) Bureau of Planning; (2) Bureau of Engineering; (3) Bureau of Information and Education; and (4) Bureau of Business Management.

The Division of Fish and Game currently is active in Lake Superior. The Section of Fisheries is carrying out programs of investigations, fish stocking, creel census, habitat improvement, and special studies to improve the sport and commercial fisheries of Minnesota. This includes the State's first introduction of coho salmon into Lake Superior in 1969.

Minnesota Department of Health

The *Minnesota Department of Health* was established in 1872. The State Board of Health was created to exercise administrative, quasi-judicial and rulemaking powers for the protection, preservation, and promotion of the public health.

Of the seven divisions within the department, the Division of Environmental Sanitation is most directly concerned with water. The division is concerned with any factors in the environment that may adversely affect the public health. Its goals are for all public water supplies to be acceptable from a sanitary standpoint by 1970, adequate sewage treatment facilities for all communities having sewer systems, and control of all industrial wastes to minimize pollution.

Minnesota Pollution Control Agency

The *Minnesota Pollution Control Agency* was created by the 1967 Legislature to assume all of the duties and responsibilities of its predecessor, the Minnesota Water Pollution Control Commission. The seven citizen members of the agency and the director are appointed by the Governor. The agency has adopted water quality standards for all interstate waters, including an implementation plan, and has recently completed a long-range water pollution control plan and program. Current water pollution control activities include classification of the intrastate waters, monitoring of lakes and streams, review of municipal and industrial waste treatment projects, inspection of operation of existing waste-water treatment facilities, conducting public education, and a wide range of other basic pollution control objectives, including surveys and evaluation studies of new pollution sources.

State Soil and Water Conservation Commission

The *State Soil Conservation Commission* was established in 1937 to promote the organization of soil and

water conservation districts throughout the State wherever desirable, to administer funds appropriated for use of these districts, and to assist them in their programs through advice and consultation.

The commission has been given responsibility under Public Law 566 to accept watershed applications and approve or disapprove them for the Governor; to determine problems, needs, and interest of the people in the watersheds along with adequacy of the application; place eligible projects on a priority for planning purposes; and administer watershed planning funds appropriated by the State Legislature for that purpose.

Water Resources Board

The *Water Resources Board* counsels with existing agencies to promote the systematic administration of water policy and to coordinate and accelerate conservation activities. The board also has jurisdiction over the establishment of watershed districts.

University of Minnesota

Since 1955, the School of Public Health and the Department of Biology at the *University of Minnesota* have carried out research in support of Lake Superior water quality criteria. Physical facilities for both research and teaching include a well-equipped laboratory at Duluth on the shore of Lake Superior. Two vessels (a 27- and a 30-foot launch), each provided with a variety of sampling devices, are stationed at the laboratory. Additional laboratory facilities are available at the new Life Science Building on the campus of the University of Minnesota, Duluth. These facilities are used in projects oriented toward research and the training of researchers on the Great Lakes.

Among the projects in progress are: A study of the open-water distribution and abundance of net plankton in Lakes Superior, Michigan, and Huron; an investigation into the relation of periphyton to water quality; an analysis of primary productivity of Lakes Superior, Huron, and Michigan surface waters using C-14 techniques; the biodynamics of Lake Superior periphyton; potential productivity of Lake Superior; preliminary studies of *Pseudomonas sp.* as an index of water quality; study of organisms of the second trophic level in Lakes Michigan and Superior, and analysis of the ecology of the epilithic periphyton of Lake Superior.

NEW YORK

New York borders on two of the Great Lakes, Erie and Ontario, and the St. Lawrence River marks the boundary between New York and Canada over part of its length. The entire U.S. portion of the area draining directly into Lake Ontario lies within New York State and encompasses one-third of the State's land

area. New York's portion of the eastern end of Lake Erie includes Niagara Falls and the Niagara River. Both are important for power production, as well as scenic beauty.

Department of Commerce

The *Department of Commerce* is responsible for industrial and economic development programs within the State. It is vitally interested in the effects of water quality on industrial and recreational developments.

Conservation Department

The divisions of the Department of Conservation have several ongoing programs relating to water quality.

The *Division of Fish and Game* has ongoing programs of stream fishing rights acquisition, fish and wildlife improvement, and fish stocking. The division's Pollution Research Section conducts investigations and research related to effects of pollution and pesticides on fish life. Activities pertinent to the Great Lakes Basin include: introduction of coho salmon in 1968 into Lake Ontario and Lake Erie with future stockings planned, as well as followup studies and special management; various fishery investigations; wet land acquisition, and participation in interstate and international planning and coordinating programs.

The *Division of Motor Boats* has programed the construction of additional harbors of refuge on the Great Lakes. Boat launching sites in the basin are also developed by the division. The division will be responsible for enforcing the installation of approved sanitary facilities on vessels using State waters.

The *Division of Parks*, as staff to the State Council of Parks, acquires and develops recreation lands and related facilities. Six park commissions, members of the State Council, are involved in the Great Lakes Basin. The development of water-oriented recreation facilities has been emphasized by these commissions. Recreation development since 1966 has been programed on the basis of a \$400 million, 10-year expenditure. This program is based on the Statewide Comprehensive Outdoor Recreation Plan.

The *Division of Water Resources* furnishes direct staff services to the Water Resources Commission and serves as its secretariat. The staff of the division makes investigations and conducts public hearings on behalf of the commission and presents recommendations to the commission on matters coming before it. On behalf of the commission, the division provides technical material for the Statewide Water Resources Plan. This will be done by integrating the regional and basin plans now being evolved by the regional boards and Federal-State planning programs, including the Great Lakes Basin Commission Framework Study.

The division carries out certain State responsibilities to various interstate and State-Federal river basin studies. The appraisal of specific project proposals, plans and technical reports that affect water resources is also its responsibility. The division provides staff services and performs and coordinates planning activities for regional water resources planning boards.

Department of Health

Article 12 of the New York Water Pollution Control Act of 1961 provided for the abolishment of the Water Pollution Control Board and the transfer of authority to the Bureau of Water Resource Services of the *Department of Health*. In 1966, this bureau was expanded and reorganized as the department's *Division of Pure Waters* and was given the responsibility for direction, supervision, coordination, and control of the department's water resources programs. The division administers Federal and State sewage works construction grants, reviews and keeps current quality standards for all water uses, supervises and carries out State enforcement activities, participates in comprehensive water resource planning studies, issues permits (and renewals) for operation of industrial and municipal waste treatment plants, and serves as State Water Coordinator. The division also conducts a research program consisting of inhouse and contract research. Grants are available to individuals or agencies for research on the prevention of water pollution.

Atomic and Space Development Authority

The Atomic and Space Development Authority may site, construct, and operate nuclear reactors for generation of electrical energy. The authority, to help promote nuclear generating plants in the State, operates the site of the first nuclear fuel reprocessing center in the Nation. The site, located in Cattaraugus County, also includes a waste disposal area and a plutonium storage area.

Office of Planning Coordination

This office is the State's central long-range planning agency. In this capacity, it sponsors both regional and statewide planning programs, coordinates the functional planning of the line agencies with the general plan, and coordinates State planning with local and Federal activities.

Port Authorities

Three authorities have been established in the basin to promote port development.

The *Niagara Frontier Port Authority* is a public benefit corporation created to operate a port district which embraces the cities of Buffalo, Lackawanna, and Tonawanda and the towns of Hamburg, Amherst, Cheektowaga, and West Seneca.

The *Ogdensburg Bridge and Port Authority* was created to construct and operate an international toll bridge between Ogdensburg, N. Y., and Prescott, Ontario. The bridge was officially opened in September 1960. In 1963, the authority was given the further responsibility of developing the Port of Ogdensburg on the St. Lawrence River.

The function of the *Port Oswego Authority* is to survey, develop, operate, and promote port facilities in the Oswego Port District which embraces the City of Oswego and the town of Scriba.

Power Authority of the State of New York

The *Power Authority of the State of New York* was created in 1931 to improve the International Rapids section of the St. Lawrence River near Massena, in cooperation with Federal and Canadian authorities. The authority is a public benefit corporation of the State which owns and operates two hydroelectric power projects, one in the St. Lawrence near Massena and the other near Niagara Falls. The aim was to create hydroelectric power and, at the same time, to clear the rapids for navigation. Membership of the authority consists of five trustees appointed by the Governor to serve overlapping terms. The authority is a wholesale power supplier, servicing 50 customers. It was recently authorized to develop nuclear baseload plants and pumped storage projects to supplement its existing plants. At both of the power projects, substantial investments in recreation facilities have been made. Administration and operation of recreational facilities at the Thousand Islands and Niagara Frontier have been turned over to the New York Conservation Department.

Pure Waters Authority

The *Pure Waters Authority* is charged with the "planning, financing, construction, maintenance and operation of sewage treatment works and solid waste disposal facilities, the construction on behalf of municipalities of sewage treatment works, sewage collecting systems and solid waste disposal facilities and the assistance of municipalities in the planning, financing, construction, maintenance and operation of sewage treatment works, sewage collecting systems and solid waste disposal facilities."

Regional Water Resources Planning Boards

New York State is currently engaged in a statewide water resources planning program. The Great Lakes Basin portion of this program is being conducted by seven regional water resources planning boards. Each of these boards is composed of seven unsalaried members representing all segments of the public. The boards are staffed by the State Division of Water Resources personnel, and board study costs are shared by the State and the counties involved. Additional participa-

tion in the studies is provided by a member of State and Federal agencies.

While having no development authority of their own, these boards will provide multipurpose plans for the development and management of water resources in their respective regions. These studies are at the approximate level of Federal type 2 studies. Although none of the boards has completed its study to this date (mid-1969), their plans may recommend some combination of new and existing State and local development programs. The status of these board studies is as follows:

Board:	Scheduled completion date
Erie-Niagara	1970
Oswego River Basin:	
Cayuga Lake	1972
Wa-Ont-Ya	1972
Eastern Oswego	1972
Genesee	1973
Black	1973
St. Lawrence	1973

Water Resources Commission

The *Water Resources Commission* is charged with coordinating the functions of every State agency concerned with water resources and formulating State policy regarding the conservation, development, and use of the State's water resources.

Serving as chairman is the State's Conservation Commissioner. Members are the Superintendent of Public Works, the Attorney General, and the Commissioners of the Departments of Health, Commerce, Agriculture and Markets, and the Office for Local Government. The membership is completed by four lay advisors representing industry, political subdivisions, agriculture, and the sportsmen of the State.

Among the commission's major duties are: Planning and development of water resources; undertaking studies for the protection, conservation, development, and use of water resources of any region of the State; apportionment of water supply for public water systems; classification of streams for pollution control; drainage of agricultural lands, river regulation and river improvement through districts set up for these purposes; flood control; planning of water supply for intermunicipal areas, and stream protection through control of the construction of dams and locks. The commission also has the right of eminent domain.

The Water Resources Commission, through its member agencies, acts as the agent for the State of New York in partnership ventures with Federal and local entities and represents the State's interest in interstate water resources planning and development work.

The commission may draw upon the various agencies represented thereon for specialized staff services. The primary staff arm of the commission is the Conservation Department's Division of Water Resources.

Alfred University

Alfred University is situated in the region of a physiographic divide from which the waters drain into the St. Lawrence, the Susquehanna, and the Mississippi. The area presents an ideal site for controlled experiments concerning air and water pollution, distribution of pesticides, etc. Investigations currently being conducted by the Departments of Biology, Chemistry, and Geology relate, in part, to the physical and biological characteristics of the terrestrial and aquatic systems of the Alfred area.

The program offers a unique opportunity for training in deep-water aquatic techniques. A research vessel based on Seneca Lake at Watkins Glen, N.Y., is leased by Alfred University from the College Center of the Finger Lakes. This vessel is available for use in regularly scheduled courses and for independent research. Present activities on Seneca Lake include studies of its bottom topography, the distribution of the sediments, pesticide concentration, and thermal stratification.

Cornell University

Water Resources and Marine Science Center

In 1964 the State of New York authorized a water resources institute at *Cornell University* under the Water Resources Research Act. This institute later became the *Water Resources and Marine Science Center* of the University. This interdisciplinary organization operates horizontally across the University at the graduate study and research level. Its purpose is to develop and maintain a comprehensive program in water resources planning, development and management in such areas as the sciences, engineering, agriculture, law, economics, government, regional planning, and public health. The center places high priority on Great Lakes research including the Finger Lakes, eastern Lake Erie, Lake Ontario, and the St. Lawrence River within the United States. Approximately 75 faculty members are engaged in an equal number of research programs in water and related land resources and in the marine sciences. The center has an extensive publications program and lists of publications are available on request. It also has published six annual indexes to the water resources periodical literature, and a thermal pollution bibliography and has initiated a quick index to Great Lakes literature.

State University College at Buffalo

The *Great Lakes Laboratory*, of the *State University College at Buffalo*, conducts an education-research program which has involved students and staff from over 10 units of the State University of New York. The program is administered by a director who is assisted by two advisory boards.

Areas of possible study include physical and chemical characteristics of water under varying degrees and types of pollution, aquatic life, terrestrial plants and animals in an area undergoing ecological change, shoreline erosion, the nature and quantity of sedimentation, influences of Lake Erie on weather and climate, and the interactions of pollution and socioeconomics of the Niagara Frontier.

Investigations being conducted at the Great Lakes Laboratory with non-State University of New York funds include: (1) Survey of the chemical and physical effects of dredging on Buffalo Harbor (Corps of Engineers); (2) rejuvenation of the Buffalo River (Allied Chemical Corp.); (3) effects of slag deposition on Lake Erie fisheries (Bethlehem Steel); and (4) BOD-COD ratios of selected effluents (Hooker Chemical Corp.)

State University of New York at Buffalo

Activities concerned with the Great Lakes began in the fall of 1963 at the *State University of New York at Buffalo* with the addition of faculty interested in hydrodynamics, water resources, and water quality. The principal purpose is undergraduate and graduate education in engineering and applied sciences. Activities includes dynamic model studies of Lakes Erie and Ontario and the publishing of a symposium "Fresh Water of New York State: Its Conservation and Use."

OHIO

Lake Erie is a great asset to the State of Ohio. The lake drains 29 percent of the State's land area, and over 40 percent of Ohio's population resides in the Lake Erie Basin. The area is intensely urbanized and industrialized and also includes some of the most productive agricultural land in the State.

Development Department

The *Development Department* works to ensure the best use of State resources in the interest of a balanced economy and continuing economic growth. It is directly involved with developmental and planning efforts concerning Lake Erie and lands within the Lake Erie Basin. A State development plan is currently being prepared and is expected to be completed in 1971.

Water and Sewer Rotary Commission

The *Water and Sewer Rotary Commission* was created by legislation in 1965 to supervise State loans to counties to meet that portion of the cost of the extension of water and sewer lines which is to be financed by assessments which are deferred. When water or sewer lines are extended across open farm land to new industrial or commercial developments, assessments normally levied against the intervening open land may be covered by a rotary loan until such time as the open land is developed. The Commission

is composed of three appointed members plus the Directors of Development, Health, Agriculture, and Natural Resources. It is attached to the Department of Development.

Department of Health

The objective of the Division of Engineering of the *Department of Health*, Bureau of Environmental Health, is to provide adequate sanitary facilities to safeguard the public health. This includes technical and administrative participation in the planning, design, operation and maintenance of all elements of community life related to the protection and promotion of public health. These elements include control of water supply, waste-water treatment and disposal, planning of subdivisions and other environmental conditions to minimize disease, accidents, and health hazards. Pollution studies of streams and lakes are made by the division in accordance with this objective.

The Division of Engineering supports the Water Pollution Control Board with technical assistance and staff.

Water Pollution Control Board

The Water Pollution Control Act of 1951 created the *Water Pollution Control Board*, which functions within the Department of Health, with administrative, regulatory, and quasi-judicial powers. The board has authority to develop programs for the prevention, control, and abatement of water pollution, including investigation, research, education, and enforcement. It can require the construction or modification of sewage and waste disposal systems. New water quality standards for interstate streams were adopted in 1967. The board has set time schedules for the installation of waste treatment improvements that will achieve the goals of these standards. The necessary new treatment facilities discharging into any of the streams in the Lake Erie watershed serving industry or municipalities are to be completed by 1970.

Department of Natural Resources

The *Department of Natural Resources* was established in 1949 to bring together various State agencies engaged in conservation of natural resources. The director is appointed by the Governor and coordinates the activities of eight divisions. Five of these are directly concerned with water. They are: Forestry and Reclamation, Parks and Recreation, Water, Watercraft, and Wildlife. Two divisions—Geological Survey and Lands and Soil—provide services related to water. The Division of Oil and Gas is a regulatory agency that contributes to the water resources management in policing well site pollution and in the supervision of subsurface disposal of industrial wastes. The Lake Erie Section of the Division of Geological Survey is conducting studies on water masses, currents, bottom conditions

and sediments, shore erosion processes, erosion abatement, shoreline geology, bottom topography, geology of reef and island areas, and subaqueous mineral resources. The Engineering Section acts as the shore erosion agency of the State and issues permits for beach and shore erosion devices on Lake Erie. The Water Planning and Water Management Sections have important responsibilities in their subject areas.

Department of Public Works

The *Department of Public Works* was established by organic legislation and is headed by a director who is appointed by the Governor. The department has been designated as the custodian of the submerged lands of Lake Erie and provides for their leasing. The department's activity in the Great Lake includes leasing by the State Canal and Land Authority of offshore and submerged canal lands for purposes of public or private development. The authority functions within the Department's Division of Real Estate.

Department of Urban Affairs

The *Department of Urban Affairs* was established by legislative action in 1967 and is headed by a director who is appointed by the Governor. Divisions coordinated by the director are: (1) Intergovernmental Services; (2) Legal Services; (3) Public Finance; (4) Urban Development; (5) Office of Opportunity, and (6) Ohio Office of Appalachia. The Department is particularly active in assisting communities to coordinate legal, fiscal, and developmental programs. It also coordinates Federal assistance applications from major metropolitan areas.

Ohio Water Commission

The *Ohio Water Commission* was created to coordinate water programs in Ohio, to develop water supply, flood control and flood plain zoning programs for all areas of the State, and to obtain the most beneficial use of water resources. It makes long-range water plans, holds hearings, makes studies, and makes legislative and policy recommendations to the Governor and General Assembly. Four of its members are appointed by the Governor with the advice and consent of the Senate; the other three are the directors of the Departments of Natural Resources, Health, and Development. The Commission works closely with the Ohio Division of Water of the Department of Natural Resources, as well as many other State, local and Federal agencies.

Ohio Water Development Authority

The *Ohio Water Development Authority* was established by legislative action in 1968. The Authority consists of five appointed members and the direc-

tors of Natural Resources and Health. An executive director is responsible to the Authority. The agency was authorized primarily to finance, construct, and operate water development projects.

Financing is from State voted funds and Federal funds, as well as from revenue bonds amortized by user charges. Through the latter source, pollution abatement and water management projects for private interests may be built and operated.

Ohio State University

The *Ohio State University* has had a long history of activities related to the Great Lakes. Since 1896, the University has maintained a biological station adjacent to Lake Erie. The Franz T. Stone Laboratory was established on Gibraltar Island at Put-in-Bay in 1925. Interest in Lake Erie has developed in a number of departments at Ohio State, principally in the Departments of Economics, Civil Engineering, Geography, and Geology, among several faculties of the College of Biological Sciences, and in the School of Natural Resources. Coordination of research activity on the Great Lakes is through the Water Resources Center of the Engineering Experiment Station and through the School of Natural Resources.

The University's activities involving the Great Lakes include operation of the Franz Stone Laboratory for advanced undergraduate and graduate student training, particularly in aquatic biology. Ongoing studies include in-depth studies of limnological conditions in western Lake Erie, geophysical conditions of the lake including shore erosion, studies of algal populations, of aquatic fungi, distribution and behavior of avian populations, effect of Lake Erie on local climate, studies of eutrophication as it relates to the microbial flora, studies of bottom deposits in relation to algal bloom and phosphorus exchange, and economic analysis of factors related to eutrophication.

PENNSYLVANIA

Lake Erie is important to Pennsylvania's economy in many ways—for commerce, recreation, and as a source of public and industrial water. The portion of Pennsylvania land surface which drains into Lake Erie encompasses 512 square miles, with a population of approximately 260,000. Recreational use of the lake area is heavy and is rapidly increasing. Over 3.5 million visitor-days are recorded annually at Presque Isle State Park, accounting for annual expenditures currently estimated at \$60 million. Boating on the lake is becoming ever more popular.

Department of Forests and Waters

The *Department of Forests and Waters* is actively engaged in the development of recreational and port activities on Lake Erie. In cooperation with the Penn-

sylvania State Park and Harbor Commission of Erie, it is engaged in a long-range program for the development of the recreational potential of Presque Isle Peninsula and State Park. Since the mid-1950's the department has had a program, in cooperation with the U.S. Army Corps of Engineers, aimed at restoring and protecting Presque Isle's beaches.

The department recently advertised for bids for the leasing of offshore oil and gas lease blocks in Lake Erie. A program for a predrilling examination of the lake's bottom sediments and aquatic life, along with a detailed plan for an inspection of any drilling program, is anticipated by the department in cooperation with the Pennsylvania Department of Health and the Pennsylvania Fish Commission.

The department has begun the process of formulating a State water resources plan, in cooperation with other Commonwealth agencies, such as the Department of Health, Pennsylvania Fish Commission, etc. The planning process will consider all water resources needs of Pennsylvania's portion of the Great Lakes Basin, and the plan will provide a guideline for water resources development therein.

Water and Power Resources Board

The *Water and Power Resources Board* of the Department of Forests and Waters is empowered to regulate all changes in the course or cross section of the waters of the Commonwealth and the construction and maintenance of encroachments (dams, wharves, walls, bridges, etc.) upon them. The board also allocates surface waters to public water supply agencies.

Department of Health

Sanitary Water Board

The *Sanitary Water Board* of the *Department of Health* is responsible for water pollution control in the Commonwealth and has been conducting programs designed to control water pollution in the Pennsylvania portion of the Lake Erie Basin. The Department of Health operates a water pollution control laboratory in Erie in which chemical and bacteriological analyses are conducted for the Lake Erie area.

A Great Lakes Research Institute has recently been established in Erie which will undertake water resources research in addition to other research.

Pennsylvania Fish Commission

The *Pennsylvania Fish Commission* consists of eight members appointed by the Governor and is responsible for the management of the Commonwealth's fishery resources. Current joint, Federal-Commonwealth projects on Lake Erie consist of: A program to establish coho salmon in the Pennsylvania waters of Lake Erie in an attempt to produce a high-quality game fish and

possibly a commercial fishery; a program to increase the production of high-value commercial fishes in Lake Erie by the introduction of a high-value exotic species; a program to restore populations of once abundant high-value fishes; and a program to conduct environmental studies of biological conditions affecting fish populations in Lake Erie.

A research vessel, the *Perca*, has been recently refurbished and equipped with modern gear and is being used to study fish populations and their environment in the Pennsylvania waters of Lake Erie. Emphasis is being placed on a study of the walleye to determine origin and spawning areas of the stocks of the eastern basin and to develop management procedures for maintaining a good and constant harvest of this species.

If the results of planting coho fingerlings in the tributaries of Lake Erie continue to be satisfactory, the commission will consider constructing a new fish hatchery to propagate coho salmon and possibly other species.

Carnegie-Mellon University

The *Carnegie-Mellon University* has been conducting research to assess the extent of organic contaminants present along the southern shore of Lake Michigan. This research has been done at various water treatment plants and has served as an aid in determining the source of contaminants causing sporadic taste and odor incidents at water treatment plants.

WISCONSIN

Wisconsin has a long history of pioneering in the scientific and legal aspects of water resource conservation and utilization through resolution of the problems associated with exploitation of timber resources and development around her many inland lakes and streams. Location on the shores of both Lakes Superior and Michigan has been advantageous for recreational and navigational development. The Lake Michigan drainage includes about 14,000 square miles and 495 miles of shoreline; the Lake Superior drainage includes over 3,000 square miles with 325 miles of shore line. The coasts of both lakes are well known for their recreational aspects. The Door Peninsula in Lake Michigan and the Apostle Island group in Lake Superior enjoy national fame.

Department of Natural Resources

The *Department of Natural Resources* was created as part of an extensive reorganization of State agencies in 1967. Six divisions have been created within the department. These are: Trust Lands and Investment, Tourism and Information, Forestry and Recreation, Fish and Game Enforcement, Environmental Protection, and Services.

The activities of these divisions on the Great Lakes include law enforcement; providing public access to the

lakes, via parks, public fishing areas, harbors and boat launching facilities; improving fishing through research, special studies and investigations, and stocking of lake trout, brown trout, coho salmon and other species; land acquisition; administration of the flood plain and shore land management programs; administration of State statutes relating to removal and fill in the Great Lakes, and administration of the State water pollution control program.

University of Wisconsin

At the present time two campuses of the *University of Wisconsin* have major programs concerning the Great Lakes. The Madison campus operates through the *Marine Studies Center* while the Milwaukee campus operates through the *Center for Great Lakes Studies*. These two campus centers are tied together through the all-university Marine Studies Program which is overseen by the all-university Council for Marine Sciences. In 1968 Wisconsin became the first inland university to receive institutional support under the Sea Grant College Program.

The *Marine Studies Center* was established in the graduate school on the Madison campus in 1967. This center serves to focus the marine related (including Great Lakes) research activities of faculty members in various departments on the Madison campus. It also coordinates its activities with the Center for Great Lakes Studies at the Milwaukee campus. Its activities include broad interdisciplinary research programs on Green Bay and the adjacent areas of Lake Michigan, studies on the circulation of Lake Superior, geophysical and geological studies of the Great Lakes, programs on fish orientation and movements, and an industry and community relations program designed to foster a closer partnership with the University in identifying and working on Great Lakes problems of all kinds.

The *Center for Great Lakes Studies* at Milwaukee has been established to contribute to research in education toward a better understanding of physical, chemical, and biological processes and events occurring in the Great Lakes and in their drainage basins and of the associated social influences and needs. The two main themes of biological research at the center have been related to (a) fisheries and (b) the eutrophication process in the Great Lakes. Other studies are concerned with the physical and chemical characteristics of the lakes, and studies are being conducted in the socioeconomic field, including projection of future shipping at Great Lakes ports.

The *Water Resources Center* at the University is the organizational unit which coordinates and administers research funds provided under the Water Resources Research Act of 1964. There are several projects that are conducted within the Great Lakes Basin and a number of others that cover topics that have a direct bearing on the potential water resources man-

agement of the basin. The center coordinates projects at the Madison and Green Bay campuses, as well as at the Oshkosh, Whitewater and Superior campuses of Wisconsin State University and at Marquette University. In addition, the FWPCA supports a significant research program at Madison on eutrophication of natural waters. Both the Federal Government and private industry provide funds for the development and operation of an information program on the subject.

The Water Resources Center has been designated by the Office of Water Resources Research as the "center of competence" for selecting, abstracting, and

indexing pertinent literature in the area of eutrophication.

Geological and Natural History Survey

Located at the University Extension in Madison, the *Geological and Natural History Survey* is concerned with studies of the soil, water and mineral resources of the State. It conducts field studies and research, and prepares interpretive maps and reports. Its responsibility also includes topographic mapping of the State. Most of its programs are conducted in cooperation with such Federal agencies as the U.S. Geological Survey and the USDA Conservation Service.

Private

Public education and information is a necessary adjunct of water resource research, planning, and particularly of development or implementation of plans. Enlightened private organizations, such as foundations, associations, League of Women Voters, watershed councils, federations of civic associations and others, perform an essential function of interpretation to their clientele. This listing includes some of the more noteworthy groups.

American Shore and Beach Preservation Association

The *American Shore and Beach Preservation Association* is a private nonprofit association. Its purpose is the preservation of beaches on seacoast and Great Lakes shores of the United States through attempts to effect a correlation between Federal, State, and local interests in beach erosion problems.

Great Lakes Foundation

The *Great Lakes Foundation* (GLF) is a nonprofit organization dedicated to the promotion of research and education in the field of fresh water. Its aims are two-fold: To increase public understanding of the problems and programs on the Great Lakes and to promote scientific research into these problems. Publication of "Limnos," magazine of the GLF, was initiated in February 1968 as one means of effecting the aim of promoting public understanding of the problems facing the Great Lakes. A research committee chooses research proposals which are in accord with the goals of the Foundation and which are deemed worthy of support.

Developing Great Lakes Megalopolis Research Project, Inc.

The *Developing Great Lakes Megalopolis Research Project, Inc.*, is a private nonprofit corporation created specifically to organize, coordinate and sponsor research leading to action programs for achieving the full potential of future growth and development in the Great Lakes Megalopolis.

The project deals with the area surrounding the Great Lakes, with primary focus on the development of the urban system extending from Milwaukee through Chicago, Detroit, Toledo, Cleveland, and

Pittsburgh to Buffalo. Extensions of this urban system in Canada will also be studied.

Although concentrating primarily on regional and interregional physical planning, the project will also examine water resources to the extent necessary to formulate policies and programs for better management of the environment supporting the system of cities around the Great Lakes.

Great Lakes Historical Society

The objectives of the *Great Lakes Historical Society* are to: promote interest in discovering and preserving material on the Great Lakes and the Great Lakes area of the United States and Canada, such as books, documents, records, and objects relating to the history, geography, geology, commerce, and folklore of the Great Lakes; centralize information regarding such collections through the cooperative efforts of local historical societies and libraries throughout the area; publish "Inland Seas," an illustrated quarterly journal devoted to Great Lakes history and the promotion of the interests of the Society, and sponsor the Great Lakes Historical Society Museum at Vermilion, Ohio.

Lake Carriers' Association

The *Lake Carriers' Association* (LCA) was founded in 1880. Its members are operators of Great Lakes bulk cargo ships. Its special committees include: Finance, Legislative, Shore Captains, Fleet Engineers, Taxation, Smoke Abatement, Canadian Conference, and Welfare. The LCA publishes a monthly bulletin and an annual report.

National Rivers and Harbors Congress

The *National Rivers and Harbors Congress* (NR&HC) was founded in 1901. The Congress promotes the continued improvement, development, and utilization of the Nation's rivers, harbors, lakes, and water and land resources. Special committees have been established on Projects, Municipal and Industrial Water Use and Pollution Abatement, Irrigation and Reclamation, and Wildlife and Recreation. Over 50 State groups have been formed. Members represent State, city and county agencies; water and land development associations; agricultural, commercial,

industrial, labor and civic organizations; business firms and individuals in navigation, irrigation and flood control.

Ohio Historical Society

The *Ohio Historical Society* collects printed, manuscript, and pictorial materials on the history of Ohio

and the Old Northwest Territory and the archaeology and natural history of the State. In addition to books, pamphlets, newspapers and maps, the library contains over 1.5 million manuscripts. These include diaries, journals, the correspondence of Ohio Governors and U.S. Presidents from Ohio, as well as papers of other public figures of the State.

Appendix A

Marine and Marine-Related Organizational Addresses

This appendix contains the addresses of those organizations discussed in the text, as well as addresses of organizations whose interests, while primarily land oriented, have broad spectrum responsibilities which affect water resources. Many Federal agencies have major field offices in the Great Lakes area, and these field offices are also listed.

Telephone numbers printed in *italics* are part of the Federal Telecommunications System (FTS).

UNITED STATES-CANADIAN COOPERATION

Chairman, Canadian Section
International Joint Commission
United States and Canada
151 Slatter
Ottawa 4, Ontario, Canada

Chairman, United States Section
International Joint Commission
United States and Canada
1711 New York Avenue NW.
Washington, D.C. 20440
(202) 347-3733

Mr. H. F. Lawhead, Member
Coordinating Committee on Great Lakes
Basic Hydraulics and Hydrologic Data
U.S. Army Engineer Division, North Central
536 South Clark Street
Chicago, Ill. 60605

Mr. Louis D. Kirshner, Member
Coordinating Committee on Great Lakes
Basic Hydraulic and Hydrologic Data
U.S. Army Engineer District, Lake Survey
630 Federal Building and U.S. Courthouse
Detroit, Mich. 48226

Executive Secretary
Great Lakes Fishery Commission
1451 Green Road
Post Office Box 640
Ann Arbor, Mich. 48107
(313) 665-6847

Mr. C. F. McNish
Chairman, U.S. Section
Great Lakes Study Group
Steering Committee
U.S. Army Engineer Division, North Central
536 South Clark Street
Chicago, Ill. 60605
(312) 353-6385 (312) 353-6406

Mr. Norman Baldwin, Secretary
International Association for Great Lakes Research
Post Office Box 640
Ann Arbor, Mich. 48107
(313) 665-6847

Mr. W. J. Drescher, Cochairman
International Field Year on the Great Lakes
U.S. Geological Survey
1815 University Avenue
Madison, Wis. 53706
(608) 231-2200

Mr. T. L. Richards, Cochairman
International Field Year on the Great Lakes
Meteorological Branch
Department of Transport
315 Bloor Street
Toronto 5, Ontario, Canada

CANADA

Director
Great Lakes Division
Canada Centre for Inland Waters
Post Office Box 5050
Burlington, Ontario, Canada
(416) 632-1940

Canadian Committee on Oceanography
Office of the Secretary
% Fisheries Research Board of Canada
Sir Charles Tupper Building
Confederation Heights
Ottawa 8, Ontario, Canada

Great Lakes Working Group
Canadian Committee on Oceanography
% Dr. E. K. Rodgers
Great Lakes Institute
University of Toronto
Toronto, Ontario, Canada

Canadian Council of Resource Ministers
 620 Dorchester Boulevard, West
 Suite 830
 Montreal 2, Quebec, Canada

Director
 Conservation Authorities Branch
 Department of Energy and Resources Management
 880 Bay Street
 Toronto, Ontario, Canada

Inland Waters Branch
 Department of Energy, Mines, and Resources
 588 Booth Street
 Ottawa 4, Ontario, Canada
 (613) 994-9225

Marine Sciences Branch
 Department of Energy, Mines and Resources
 615 Booth Street
 Ottawa 3, Ontario, Canada

Director
 Resource Development Service
 Department of Fisheries and Forestry
 Sir Charles Tupper Building
 Confederation Heights
 Ottawa 8, Ontario, Canada

Chief
 Public Health Engineering Division
 Department of National Health and Welfare
 Environmental Health Centre
 Tunney's Pasture
 Ottawa 3, Ontario, Canada
 (613) 992-2011 and 992-8701

Department of Public Works
 Sir Charles Tupper Building
 Confederation Heights
 Ottawa 8, Ontario, Canada

Director
 Meteorological Service
 Department of Transport
 315 Bloor Street, West
 Toronto 5, Ontario, Canada

Director
 Marine Hydraulics Branch
 Department of Transport
 Room 318, Hunter Building
 O'Connor Street
 Ottawa, Ontario, Canada
 (613) 992-0102

Conservation Council of Ontario
 85 King Street
 Toronto, Ontario, Canada

Fisheries Research Board of Canada
 Sir Charles Tupper Building
 Confederation Heights
 Ottawa 8, Ontario, Canada

President
 National Research Council of Canada
 Administration Building
 Montreal Road
 Ottawa 7, Ontario, Canada

Ontario

Chief, Fish and Wildlife Branch
 Department of Lands and Forests
 Parliament Building
 Toronto, Ontario, Canada

Chief, Research Branch
 Department of Lands and Forests
 Maple, Ontario, Canada

Hydro-Electric Power Commission of Ontario
 Toronto, Ontario, Canada

Executive Director
 Ontario Economic Council
 950 Yonge Street
 Toronto 5, Ontario, Canada

General Manager
 Ontario Water Resources Commission
 135 St. Clair Avenue West
 Toronto 7, Ontario, Canada
 (416) 365-5115

Director
 Great Lakes Institute
 University of Toronto
 Toronto 5, Ontario, Canada

Biology Department
 University of Waterloo
 Waterloo, Ontario, Canada

UNITED STATES

Department of Agriculture

U.S. Department of Agriculture
 14th Street and Independence Avenue SW.
 Washington, D.C. 20250
 (202) RE 7-4141

Agriculture Research Service
 Soil and Water Conservation Research Division
 Agricultural Stabilization and Conservation Service
 Economic Research Service
 Farmers Home Administration
 Forest Service
 Division of Flood Prevention and River Basin
 Programs
 Division of Watershed Management
 Division of Watershed, Recreation and Range
 Research
 National Agricultural Library
 Soil Conservation Service

Regional or State Offices:

Agricultural Stabilization and Conservation Service

1405 South Harrison Road
East Lansing, Mich. 48823
(517) 372-1910

Economic Research Service

North Central Resource Group
Natural Resources Economics Division
303 Manly Miles Building
East Lansing, Mich. 48823
(517) 355-1772

Farmers Home Administration

1405 South Harrison Road
East Lansing, Mich. 48823
(517) 372-1910

Eastern Region Office

U.S. Forest Service
710 North Sixth Street
Milwaukee, Wis. 53203
(414) 272-8600

Soil Conservation Service

Federal Building
200 West Church Street
Post Office Box 678
Champaign, Ill. 61820

Soil Conservation Service

311 West Washington Street
Indianapolis, Ind. 46202

Soil Conservation Service

Room 101, 1405 South Harrison Road
East Lansing, Mich. 48823
(517) 372-1910

Soil Conservation Service

200 Federal Building
U.S. Courthouse
316 North Robert Street
St. Paul, Minn. 55101

Soil Conservation Service

Midtown Plaza, Room 400
700 East Water Street
Syracuse, N.Y. 13210

Soil Conservation Service

311 Old Federal Building
Third and State Streets
Columbus, Ohio 43215

Soil Conservation Service

Federal Building and Courthouse
Box 985
Harrisburg, Pa. 17101

Soil Conservation Service

4601 Hammersley Road
Post Office Box 4248
Madison, Wis. 53711

Department of Commerce

U.S. Department of Commerce

Washington, D.C. 20235
(202) ST 3-5200

Business and Defense Services Administration

Economic Development Administration

Maritime Administration

Office of Business Economics

Environmental Science Services Administration

U.S. Department of Commerce

Rockville, Md. 20852

(301) 656-4060

Regional Office:

North Central Area Office

Economic Development Administration

200 West Superior Street

Duluth, Minn. 55802

(218) 727-6692

Department of Defense

Office of the Chief of Engineers

Department of the Army

Washington, D.C. 20315

(202) 697-2925 or 697-7926

Regional Offices:

Division Engineer

U.S. Army Engineer Division, North Central
Room 1004

536 South Clark Street

Chicago, Ill. 60605

(312) 353-6385 (312) 353-6310

District Engineer

U.S. Army Engineer District, Buffalo

Foot of Bridge Street

Buffalo, N.Y. 14207

(716) 876-5454

District Engineer

U.S. Army Engineer District, Chicago

219 South Dearborn Street

Chicago, Ill. 60604

(312) 353-6420 (312) 353-6400

District Engineer

U.S. Army Engineer District, Detroit

Post Office Box 1027

Detroit, Mich. 48231

(313) 963-1261 (313) 963-1412

District Engineer

U.S. Army Engineer District, Lake Survey

630 Federal Building

Detroit, Mich. 48226

(313) 226-6162

District Engineer
U.S. Army Engineer District, St. Paul
1217 U.S. Post Office and Customhouse
St. Paul, Minn. 55101
(612) 228-7506 (612) 228-7501

Department of the Navy
Office of Naval Research
Washington, D.C. 20360
(202) 696-5104

Department of Health, Education and Welfare

Regional Program Chief
Environmental Control Administration
Department of Health, Education and Welfare
335 Independence Avenue SW.
Washington, D.C. 20201
(202) 963-1110

Regional Representative
Bureau of Water Hygiene
Environmental Control Administration
Public Health Service
Department of Health, Education and Welfare
433 West Van Buren Street
Chicago, Ill. 60607
(312) 353-5244

Department of Housing and Urban Development

Community Resources Development Administration
Department of Housing and Urban Development
451 Seventh Street SW.
Washington, D.C. 20410
(202) 755-4000

Regional Administrator
Department of Housing and Urban Development
369 North Michigan Avenue
Chicago, Illinois 60601
(312) 353-5680

Department of the Interior

Department of the Interior
18th and C Streets NW.
Washington, D.C. 20242
(202) 343-1100

Bureau of Commercial Fisheries
Bureau of Mines
Bureau of Outdoor Recreation
Bureau of Sport Fisheries and Wildlife
U.S. Geological Survey
National Park Service
Office of Water Resources Research
(202) 343-5975

Federal Water Pollution Control Administration
633 Indiana Avenue NW.
Washington, D.C. 20242
(202) 962-1070

Regional Offices:

Regional Director
Bureau of Commercial Fisheries
5 Research Drive
Ann Arbor, Mich. 48103
(313) 663-8541

Regional Director
Bureau of Mines
Twin Cities Office of Mineral Resources
East 58th Street at Mississippi River
Minneapolis, Minn. 55417

Regional Director
Bureau of Outdoor Recreation
Lake Central Region
3853 Research Park Drive
Ann Arbor, Mich. 48104
(313) 663-8541

Regional Director
Northeast Region
Bureau of Sport Fisheries and Wildlife
U.S. Post Office and Courthouse
Boston, Mass. 02019
(617) 223-2961

Regional Director
North Central Region
Bureau of Sport Fisheries and Wildlife
1006 West Lake Street
Minneapolis, Minn. 55408
(612) 725-3500

Regional Director
Federal Water Pollution Control Administration
33 East Congress Parkway
Chicago, Ill. 60605
(312) 353-5250

Regional Hydrologist
Mid-Continent Region
Water Resources Division
U.S. Geological Survey
Suite 212, West Port 104 Building
2222 Schuetz Road
St. Louis, Mo. 63141
(314) 368-7224

Research Hydrologist
Mid-Continent Region
Water Resources Division
U.S. Geological Survey
1815 University Avenue
Madison, Wis. 53706
(618) 231-2200

District Chief
Illinois District
Water Resources Division
U.S. Geological Survey
Post Office Box 1026
605 North Neil Street
Champaign, Ill. 61820
(217) 359-3918 (217) 356-1143

District Chief
Indiana District
Water Resources Division
U.S. Geological Survey
Room 516, 611 North Park Avenue
Indianapolis, Ind. 46204
(317) 633-7398

District Chief
Michigan District
Water Resources Division
U.S. Geological Survey
700 Capitol Savings and Loan Building
112 East Allegan Street
Lansing, Mich. 48933
(517) 372-1561

District Chief
Minnesota District
Water Resources Division
U.S. Geological Survey
1002 Post Office Building
St. Paul, Minn. 55101
(612) 725-7841

District Chief
New York District
Water Resources Division
U.S. Geological Survey
Post Office Box 948
Albany, N.Y. 12201
(518) 472-3107

District Chief
Ohio District
Water Resources Division
U.S. Geological Survey
975 West Third Avenue
Columbus, Ohio 43212
(614) 469-5553

District Chief
Pennsylvania District
Water Resources Division
U.S. Geological Survey
Post Office Box 1107
Fourth Floor Federal Building
228 Walnut Street
Harrisburg, Pa. 17108
(717) 787-3917 (717) 787-3420

District Chief
Wisconsin District
Water Resources Division
U.S. Geological Survey
1815 University Avenue
Madison, Wis. 53706
(608) 262-2488

National Park Service
317 Manly Miles Building
Harrison Road
Lansing, Mich. 48823
(517) 372-1910

Department of Transportation .

U.S. Coast Guard
Department of Transportation
1300 E Street
Washington, D.C.
(202) 964-5314

Commanding Officer
U.S. Coast Guard
Ninth District, Great Lakes Area
1240 East Ninth Street
Cleveland, Ohio 44199
(216) 522-3950

St. Lawrence Seaway Development Corporation
Seaway Circle
Post Office Box 520
Massena, N.Y. 13662
(315) 764-0271

Other Organizations

Chairman
Atomic Energy Commission
Washington, D.C. 20545
(202) 973-1000

Chairman
Federal Power Commission
441 G Street NW.
Washington, D.C. 20426
(202) 386-4566

Chairman
Great Lakes Basin Commission
220 East Huron
Ann Arbor, Mich. 48108
(313) 763-3590 (313) 663-8433

Executive Director
Great Lakes Commission
2200 North Campus Boulevard
Ann Arbor, Mich. 48105
(313) 665-9135

National Research Council
National Academy of Sciences
2101 Constitution Avenue NW.
Washington, D.C. 20418

National Council on Marine Resources and Engineering Development

Executive Office of the President
Washington, D.C. 20500

National Science Foundation
Environmental and Systematic Biology
1800 G Street NW.
Washington, D.C. 20550
(202) 343-7888

Smithsonian Institution
Office of Oceanography and Limnology
1000 Jefferson Drive SW.
Washington, D.C. 20500
(202) 628-1810

Chairman
Water Resources Council
Suite 900
1025 Vermont Avenue NW.
Washington, D.C. 20005
(202) 382-6104

Mr. Harold C. Jordahl
Upper Great Lakes Regional Economic Development Commission
Suite 208
303 Price Place
Madison, Wis. 53705
(608) 233-8166

STATES AND UNIVERSITIES

Dr. Carlisle P. Runge, Director
Council on Economic Growth, Technology and Public Policy
Committee on Institutional Cooperation
Law School
University of Wisconsin
Madison, Wis. 53706
(606) 262-2240

ILLINOIS

Director
Department of Agriculture
Division of Soil and Water Conservation
Fairgrounds
Springfield, Ill. 62706
(217) 525-2274

Director
Department of Conservation
102 State Office Building
Springfield, Ill. 62706
(217) 525-6302

Chief
Illinois State Water Survey
Department of Education and Registration
Post Office Box 232
Urbana, Ill. 61802
(217) 333-2210

Sanitary Water Board
616 State Office Building
Springfield, Ill. 62706
(217) 525-6580

Division of Sanitary Engineering
Department of Public Health
State Office Building
Springfield, Ill. 62706
(217) 525-6580

Division of Waterways
Department of Public Works and Buildings
201 West Monroe Street
Springfield, Ill. 62706
(217) 525-2503

Chairman
Biology Department
Illinois Institute of Technology
Chicago, Ill. 60616

Chief
Illinois Natural History Survey
Natural Resources Building
Urbana, Ill. 61801
(217) 333-6880

Department of Biological Sciences
Northern Illinois University
DeKalb, Ill. 60115

The Technological Institute
Northwestern University
Evanston, Ill. 60201

Water Resources Center
2535 Hydrosystems Laboratory
University of Illinois
Urbana, Ill. 61801
(217) 333-0536

INDIANA

Director
Department of Natural Resources
603 State Office Building
100 North Senate Avenue
Indianapolis, Ind. 46204
(317) 633-5267

Assistant Commissioner for Environmental Health
Indiana State Board of Health
1330 West Michigan Street
Indianapolis, Ind. 46206
(317) 663-4420

Executive Secretary
State Soil and Water Conservation Commission
Room 5, A.E.S. Building
Purdue University
Lafayette, Ind. 47907

Technical Secretary
Stream Pollution Control Board
State Board of Health Building
1330 West Michigan Street
Indianapolis, Ind. 46206
(317) 633-4420

Water Resources Research Center
Life Science Building
Purdue University
Lafayette, Ind. 47907
(317) 749-2892

Dr. Harry C. Saxe
Chairman, Department of Civil Engineering
Notre Dame University
Notre Dame, Ind. 46556

MICHIGAN

Executive Secretary
Soil Conservation Committee
Department of Agriculture
324 Natural Resources Building
East Lansing, Mich. 48823
(517) 355-3346

Director
Department of Natural Resources
Stevens T. Mason Building
Lansing, Mich. 48926
(517) 373-1220

Director
Department of Public Health
Division of Environmental Health
3500 North Logan Street
Lansing, Mich. 48914
(517) 373-1321

Michigan State Waterways Commission
Stevens T. Mason Building
Lansing, Mich. 48926
(517) 373-0626

Executive Secretary
Water Resources Commission
200 Mill Street
Lansing, Mich. 48916
(517) 373-3560

Institute of Water Research
Michigan State University
East Lansing, Mich. 48823

Office of Research and Development
Northern Michigan University
Marquette, Mich. 49955

Great Lakes Research Division
University of Michigan
North University Building
Ann Arbor, Mich. 48104
(313) 764-2420

MINNESOTA

Department of Agriculture
State Office Building
St. Paul, Minn. 55101
(612) 221-6187

Commissioner
Department of Conservation
301 Centennial Building
658 Cedar Street
St. Paul, Minn. 55101
(612) 221-2549

Department of Economic Development
57 West Seventh Street
St. Paul, Minn. 55101
(612) 221-2887

Minnesota Department of Health
717 Delaware Street SE.
Minneapolis, Minn. 55440
(612) 339-7751

Minnesota Pollution Control Agency
717 Delaware Street SE.
Minneapolis, Minn. 55440
(612) 339-8571

School of Public Health
University of Minnesota
Minneapolis, Minn. 55455

Executive Secretary
State Soil and Water Conservation Commission
University of Minnesota
St. Paul, Minn. 55101
(612) 221-3767

Administrative Secretary
Water Resources Board
353 Centennial Building
St. Paul, Minn. 55101
(612) 221-2577

Water Resources Planning Director
State Planning Agency
St. Paul, Minn. 55101
(612) 646-6309

NEW YORK

Secretary
Division of Fish and Game
State Fish and Wildlife Management Board
State Campus
Albany, N.Y. 12226
(518) 457-5690

Division of Environmental Health Services
State Department of Health
84 Holland Avenue
Albany, N.Y. 12208
(518) 474-2061

Unit Leader
New York Cooperative Fishery Unit
Fennell Hall
Cornell University
Ithaca, N.Y. 14850
(607) 275-2014

New York State Power Authority
10 Columbus Circle
New York, N.Y. 10019
(212) 265-6510

Departments of Biology and Geology
Alfred University
Alfred, N.Y. 14802
(607) 587-8122 Biology
(607) 587-3712 Geology

Executive Secretary
State Soil and Water Conservation Committee
Caldwell Hall
Cornell University
Ithaca, N.Y. 14850
Water Resources Center
Cornell University
Ithaca, N.Y. 14850
(607) 275-2385

Director
Great Lakes Laboratory
Division of Mathematics and Sciences
State University College at Buffalo
5 Porter Avenue
Buffalo, N.Y. 14201
(716) 862-5422

Department of Civil Engineering
State University of New York at Buffalo
Buffalo, N.Y. 14214

Department of Geology
Syracuse University
Syracuse, N.Y. 13210

OHIO

Director
Ohio Development Department
65 South Front Street
Columbus, Ohio 43215
(614) 469-2480

Executive Director
Ohio Water Development Authority
2340 LeVeque Lincoln Tower
50 West Broad Street
Columbus, Ohio 43215
(614) 469-5822

Director
Ohio Department of Health
Post Office Box 118
Columbus, Ohio 43215
(614) 469-2253

Director
Ohio Department of Natural Resources
907 Ohio Departments Building
Columbus, Ohio 43215
(614) 469-3770

Ohio Department of Public Works
Ohio Departments Building
Columbus, Ohio 43215
(614) 469-4133

Director
Ohio Department of Urban Affairs
3500 LeVeque Lincoln Tower
50 West Broad Street
Columbus, Ohio 43215
(614) 469-5467

Executive Secretary
Ohio Water and Sewer Rotary Commission
Box 1001, 65 South Front Street
Columbus, Ohio 43215
(614) 469-2259

Water Pollution Control Board
Post Office Box 118
Columbus, Ohio 43216
(614) 469-4891

Director
Ohio Agricultural Research and Development Center
Wooster, Ohio 44691
(216) 264-1021

Unit Leader
Ohio Cooperative Fishery Unit
Ohio State University
1735 Neil Avenue
Columbus, Ohio 43210
(614) 293-8961

Unit Leader
Ohio Cooperative Wildlife Research Unit
Ohio State University
Columbus, Ohio 43210
(614) 293-6112

Executive Secretary
Soil and Water Conservation Committee
Ohio State University
1827 Neil Avenue
Columbus, Ohio 43210
(614) 294-3997

Director
School of Natural Resources
Ohio State University
124 West 17th Avenue
Columbus, Ohio, 43210
(614) 293-2265

Water Resources Center
Ohio State University
1791 Neil Avenue
Columbus, Ohio 43210
(614) 293-6108

Department of Biology
University of Akron
Akron, Ohio 44304

PENNSYLVANIA

Secretary
Department of Forests and Waters
Post Office Box 1467
Harrisburg, Pa. 17120
(717) 787-2814

Chairman
Sanitary Water Board
Pennsylvania Department of Health
Post Office Box 90
Harrisburg, Pa. 17120
(717) 787-6436

Bureau of Topographic and Geologic Survey
Pennsylvania State Planning Board
Harrisburg, Pa. 17120
(717) 787-2169

Unit Leader
Pennsylvania Cooperative Fishery Unit
208 Life Sciences Building
Pennsylvania State University
University Park, Pa. 16802
(814) 865-6592

Unit Leader
Pennsylvania Cooperative Wildlife Research Unit
Pennsylvania State University
University Park, Pa. 16802
(814) 865-4511

Executive Director
Pennsylvania Fish Commission
Post Office Box 1673
Harrisburg, Pa. 17120
(717) 787-6593

Executive Secretary
Pennsylvania Soil and Water Conservation
Commission
2301 North Cameron Street
Harrisburg, Pa. 17120
(717) 787-3267

Vice President for Research
Pennsylvania State University
207 Old Main Building
University Park, Pa. 16802
(814) 865-6331

Water Resources Center
Pennsylvania State University
University Park, Pa. 16802
(814) 865-8355

Department of Civil Engineering
Carnegie Institute of Technology
Schenley Park
Pittsburgh, Pa. 15213
(381) 621-2600

WISCONSIN

Department of Natural Resources
Post Office Box 450
Madison, Wis. 53701
(608) 266-2121

Executive Secretary
Soil Conservation Board
Room 110, King Hall
University of Wisconsin
Madison, Wis. 53706
(608) 262-2634

Director
Geological and Natural History Survey
University Extension
University of Wisconsin
1815 University Avenue
Madison, Wis. 53706
(608) 262-1705

Water Resources Center
Hydraulics and Sanitary Laboratory
University of Wisconsin
Madison, Wis. 53706
(608) 262-3577

Center for Great Lakes Studies
University of Wisconsin—Milwaukee
Milwaukee, Wis. 53201
(414) 228-4405

Marine Studies Center
University of Wisconsin
1225 West Dayton Street
Madison, Wis. 53706
(608) 262-1585

PRIVATE

American Conservation Association, Inc.
30 Rockefeller Plaza
New York, N.Y. 10020
(212) 247-8141

American Fisheries Society
1040 Washington Building
Washington, D.C. 20005
(202) 347-9717

American Geophysical Union
Suite 506
1145 19th Street NW.
Washington, D.C. 20036
(202) 333-8010

American Public Power Association
Suite 830
919 18th Street NW.
Washington, D.C. 20037
(202) 296-4215

American Public Works Association
1313 East 60th Street
Chicago, Ill. 60637
(312) 324-3400

American Shore and Beach Preservation Association
Post Office Box 1246
Rockville, Md. 20850
(301) 299-5603

American Society of Civil Engineers
United Engineering Center
345 East 47th Street
New York, N.Y. 10017
(212) 752-6800

American Society of Limnology and Oceanography
% Department of Oceanography
Oregon State University
Corvallis, Oreg. 97331
(503) 754-2991

American Society of Planning Officials
1313 East 60th Street
Chicago, Ill. 60637
(312) 324-3400

American Society of Sanitary Engineering
228 Standard Building
Cleveland, Ohio 44113
(216) 771-6677

American Water Resources Association
Post Office Box 434
Urbana, Ill. 61801
(217) 367-9695

Association of Midwest Fish and Game Commissioners
Missouri Conservation Department
Post Office Box 180
Jefferson City, Mo. 65101
(314) 636-8141

Association of State and Interstate Water Pollution
Control Administrators
% Arkansas Pollution Control Commission
1100 Harrington Avenue
Little Rock, Ark. 72202
(501) 375-4438

Chamber of Commerce of the United States
Community Regional Natural Resources Development
Group
1615 H Street NW.
Washington, D.C. 20006
(202) 628-2380

Citizens Commission on Natural Resources
1346 Connecticut Avenue NW.
Washington, D.C. 20036
(202) 387-1261

Council of State Governments
1313 East 60th Street
Chicago, Ill. 60637
(312) 324-3400

Developing Great Lakes Megalopolis Research Project,
Inc.
2200 North Campus Boulevard
Ann Arbor, Mich. 48105
(313) 764-1576

Great Lakes Foundation
2200 North Campus Boulevard
Ann Arbor, Mich. 48105
(313) 763-0108

Great Lakes Historical Society
302 Republic Building
Cleveland, Ohio 44115
(216) 241-6516

Izaak Walton League of America
1326 Waukegan Road
Glenview, Ill. 60025
(312) 724-3880

Lake Carriers' Association
Rockefeller Building, 12th Floor
Cleveland, Ohio 44113
(216) 621-1107

League of Women Voters of the United States
Water Resources Committee
1200 17th Street NW.
Washington, D.C. 20036
(202) 296-1770

National Council for Air and Stream Improvement
103 Park Avenue
New York, N.Y. 10017
(212) 889-5416

National Geographic Society
1145 17th Street NW.
Washington, D.C. 20036
(202) 296-7500

National Recreation and Park Association
1700 Pennsylvania Avenue NW.
Washington, D.C. 20001
(202) 223-3030

National Rivers and Harbors Congress
Suite 523-A
1028 Connecticut Avenue NW.
Washington, D.C. 20036
(202) 296-3116

National Sanitation Foundation
School of Public Health
University of Michigan
Post Office Box 1468
Ann Arbor, Mich. 48104

National Wildlife Federation
1412 16th Street NW.
Washington, D.C. 20036
(202) 232-8004

North Central Audubon Council
536 La Plant Street
Green Bay, Wis. 54302

Northeastern Minnesota Development Association
835 First American National Bank Building
230 West Superior Street
Duluth, Minn. 55802
(218) 722-1484

Ohio Historical Society
1813 North High Street
Columbus, Ohio 43210
(614) 299-1179

Resources For The Future, Inc.
1755 Massachusetts Avenue NW.
Washington, D.C. 20036
(202) 462-4400

Sport Fishing Institute
719 13th Street NW.
Washington, D.C. 20005
(202) 737-0668

Upper Great Lakes Economic Development
Commission
803 Landsdale Building
302 West Superior Street
Duluth, Minn. 55802
(218) 722-6635

Upper Midwest Research and Development Council
750 Federal Reserve Bank Building
Minneapolis, Minn. 55440
(612) 373-3724

Water Pollution Control Federation
3900 Wisconsin Avenue NW.
Washington, D.C. 20016
(202) 362-4100

Appendix B

Planning and Coordinating Organizational Addresses

This appendix lists institutions in the Great Lakes Basin that are involved with planning or coordination.

ILLINOIS

Executive Director
Northeastern Illinois Regional Planning Commission
400 West Madison Street
Chicago, Ill. 60606
(312) 263-1266

Director
Department of Business and Economic Development
State of Illinois
222 South College Street
Springfield, Ill. 26706

INDIANA

Allen County Plan Commission
209 National Management Building
Fort Wayne, Ind. 46802
(219) 743-0535

Area Plan Commission of St. Joseph County
129 West Colfax Avenue
South Bend, Ind. 46601
(219) 233-2955

Lake-Porter County Regional Transportation and
Planning Commission
Lake County Court House
Crown Point, Ind. 46307
(219) 663-5606

MICHIGAN

Chairman
Association of Grand Rapids Area Governments
3063 Wilson Avenue
Grandville, Mich. 49418

Bay Regional Commission
807 County Building
Bay City, Mich. 48707
(517) 892-6011

Genesee County Metropolitan Planning Commission
930 Beach Street
Flint, Mich. 48502
(313) 232-7186

Director
Huron-Clinton Metropolitan Authority
1750 Guardian Building
Detroit, Mich. 48226
(313) 961-5865

Executive Secretary
Huron River Watershed Council
415 West Washington Street
Ann Arbor, Mich. 48103
(313) 665-0514

Jackson Metropolitan Area Regional Planning
Commission
312 South Jackson, Room 514
Jackson, Mich. 49201
(517) 782-0511

Kalamazoo Metropolitan County Planning Com-
mission
County Building
227 West Michigan Avenue
Kalamazoo, Mich. 49006
(616) 343-1201

Kent County Planning Department
750 Fuller Avenue, North East
Grand Rapids, Mich. 49503
(616) 456-3731

Kent-Ottawa Regional Planning Commission
Kent County Courthouse
Grand Rapids, Mich. 49502
(616) 456-3000

Executive Secretary
Michigan Grand River Watershed Council
609 Prudden Building
Lansing, Mich. 48933
(517) 489-0552

Monroe County Planning Commission
Courthouse
Monroe, Mich. 48161
(313) 241-6066

Muskegon County Planning Commission
County Building
Muskegon, Mich. 49440
(616) 726-4711

Oakland County Planning Commission
One Lafayette Street
Pontiac, Mich. 48053
(313) 334-1531

Regional Planning and Transportation Committee
Norton Town Hall
Henry Street
Muskegon, Mich. 49441

Saginaw County Metropolitan Planning Commission
Courthouse
Saginaw, Mich. 48601
(517) 793-9100

Chairman
Southeast Michigan Council of Governments
211 West Fort Street
Detroit, Mich. 48226
(313) 961-4266

Tri-County Regional Planning Commission
535 North Clippert Street
Lansing, Mich. 48912
(517) 372-1810

Washtenaw County Metropolitan Planning Commission
306 County Building
Ann Arbor, Mich. 48108
(313) 663-7511

MINNESOTA

Duluth-Superior Metropolitan Area Planning and
Transportation Study
409 City Hall
Duluth, Minn. 55802
(218) 727-4522

Northeast Minnesota Development Authority
500 Alworth Building
Duluth, Minn. 55802
(218) 722-1484

Saint Louis County Planning Advisory Commission
305 Courthouse
Duluth, Minn. 55802
(218) 727-4522

NEW YORK

Black River-St. Lawrence Economic Development
Commission, Inc.
St. Lawrence University
Canton, New York 13617
(315) 386-4551, Ext. 264

Central New York Regional Planning and Develop-
ment Board
321 East Water Street
Syracuse, N.Y. 13202
(315) 422-8276

Erie-Niagara Basin Board
4184 Seneca Street
West Seneca, N.Y. 14244
(716) 674-6700

Erie and Niagara Counties Regional Planning Board
1880 Grand Island Boulevard
Grand Island, N.Y. 14072
(716) 693-2727

Genesee Finger Lakes Area Regional Planning Board
301 County Office Building
Rochester, N.Y. 14614

Director
Herkimer-Oneida Joint Planning Board
Oneida County Courthouse
Utica, N.Y. 13501
(315) 735-3371

Monroe County Planning Council
301 County Office Building
Rochester, N.Y. 14614
(716) 454-7200

Niagara County Industrial Development and Planning
Board
Courthouse
Lockport, N.Y. 14094
(716) 434-2871

Niagara-Frontier Transportation and Port Authority
1700 City Hall
Buffalo, N.Y. 14202
(716) 856-6524

Oneida County Department of Planning
County Courthouse
Utica, N.Y. 13501
(315) 735-3371

Onondaga County Planning Department
211 East Water Street
Syracuse, N.Y. 13202
(315) 477-7647

Wayne County Planning Board
Pearl Street
Lyons, N.Y. 11489
(315) 946-4721

OHIO

Adams County Regional Planning Commission
Mr. David R. List, Planning Director
Adams County Courthouse, Room 4
West Union, Ohio
(513) 544-3043

Akron, Cleveland, Lorain-Elyria SMSA
Northeast Ohio Areawide Coordinating Agency
ATTN: William P. Erwin, Director
378 The Arcade
Cleveland, Ohio 44114

Akron Municipal Planning Commission
Mr. James A. Alkire, Director
166 South High Street
Akron, Ohio 44308
(216) 376-1431

Ashtabula County Planning Commission
Mr. Eber L. Wright, Director
24 North Chestnut Street
Jefferson, Ohio
(216) 476-4916

Barberton City Planning Commission
Mr. Curtis G. White, Planning Director/Secretary
City Hall
Barberton, Ohio 44203
(216) 753-5291

Cleveland City Planning Commission
Mr. Eric Grubb, Planning Director
501 City Hall
Cleveland, Ohio 44114
(216) 694-2000

Cleveland Heights City Planning Commission
Mr. Earl J. Murphy, Planning Director
2953 Mayfield Road
Cleveland Heights, Ohio 44118
(216) 321-0100

Erie Regional Planning Commission
Mr. H. Mahnami, Director
1200 Sycamore Line
Sandusky, Ohio
(419) 625-9062

Geauga County Planning Commission
Mr. Robert Ranney, Planning Director
Courthouse Annex
Chardon, Ohio 44024
(216) 285-2222

Hancock Regional Planning Commission
Mr. William D. Leever, Director
230 East Sandusky Street
Findlay, Ohio
(419) 422-3322

Lake County Planning Commission
Mr. Jack Donovan, Director
Courthouse
Painesville, Ohio
(216) 352-6281, Ext. 306

Lakewood City Planning Commission
Mr. Eric S. Lane, Planning Director
Municipal Building
Lakewood, Ohio 44107
(216) 521-7580

Lima City Planning Commission
Mr. George Kruse, Jr., Director
607 Savings Building
Lima, Ohio 53201
(419) 225-3201

Lima-Allen County Regional Planning Commission
(701 Areawide Review Agency—Lima SMSA)
ATTN: Mr. Philip Boyle, Director
204-205 Dominion Building
Lima, Ohio 45802
(419) 224-6726

Lorain County Regional Planning Commission
Mr. Richard W. McGinnis, Director
21 Turner Block, Court Street
Elyria, Ohio 44035
(216) 332-4725

Mercer County Regional Planning Commission
Mr. Homer Frahm, Chairman
Route 3
Celina, Ohio 45822
(419) 586-7080

Northeast Ohio Council of Governments
Room 387
Arcade
Cleveland, Ohio 44114
(216) 621-1191

Ottawa Regional Planning Commission
Mr. William Dupps, Director
217 Madison Street
Port Clinton, Ohio 43452
(419) 734-2153

Regional Planning Commission
Arcade
Cleveland, Ohio 44114
(216) 522-3131

Regional Planning Commission (Cuyahoga)
Mr. William B. Henry, Director
415 The Arcade
Cleveland, Ohio 44114
(216) 861-6805

Toledo-Lucas County Planning Commission
Mr. Lawrence Murray, Planning Director
445 Huron Street
Toledo, Ohio 43604
(419) 248-5911

Toledo Metropolitan Area Council of Governments
(701 Areawide Review Agency—Toledo SMSA)
ATTN: Lawrence Murray, Director
% Toledo-Lucas County Planning Commission
445 Huron Street
Toledo, Ohio 43604

Tri-County Regional Planning Commission
Mr. Raymond Robinson, Executive Director
415 South Portage Path
Akron, Ohio 44320
(216) 535-2644

Williams County Planning Commission
Mr. M. Hummel, Chairman
Fourth Floor
Courthouse
Bryan, Ohio 43506
(419) 636-2059

Wood County Planning Commission
Mr. Milton Bengtson, Planning Director
541 West Wooster Street
Bowling Green, Ohio 43402
(419) 345-5822

PENNSYLVANIA

Erie County Planning Commission
Courthouse
Erie, Pa. 16501
(814) 456-8851

WISCONSIN

Chairman
Fox Valley Council of Governments
12th Floor, Zuelke Building
103 West College Avenue
Appleton, Wis. 54911
(414) 739-6156

Green Bay-Brown County Planning Commission
City Hall, Room 604
Green Bay, Wis. 54301
(414) 437-7611

Chairman
Intergovernmental Cooperation Council
% Village of Whitefish Bay
801 East Lexington Boulevard
Milwaukee, Wis. 53217

Director
Northeast Wisconsin Regional Planning Commission
2111 North Richmond
Appleton, Wis. 54911
(414) 739-4250

Chairman
Southeast Wisconsin Regional Planning Commission
Post Office Box 769
Waukesha, Wis. 53186
(414) 542-8083

Wolf River Basin Regional Planning Commission
1103 West Foster
Appleton, Wis. 54911
(414) 739-4250

Appendix C

Informational Sources

This appendix lists information sources for persons interested in learning more about the Great Lakes. The first section lists books about the region or individual lakes. The next section lists some recent publications by U.S. Federal agencies concerning the lakes. Single copies of these publications are free. The third section lists periodicals directly concerned with the Great Lakes. The last section lists newsletters that often contain information on the lakes.

BOOKS

- Aitken, Hugh G. J. 1954. *The Welland Canal Company: A Study in Canadian Enterprise*. Harvard University Press, Cambridge, Mass. 178 pp.
- Beeton, A. M., and D. C. Chandler. 1966. "The St. Lawrence Great Lakes" in *Limnology in North America*, edited by D. G. Frey. University of Wisconsin, Madison. 734 pp.
- Boyer, Dwight. 1968. *Ghost Ships of the Great Lakes*. Dodd, Mead & Co., New York. 294 pp.
- Engineering Institute of Canada and American Society of Civil Engineers. 1968. *Proceedings of Great Lakes Water Resources Conference, June 24-26, 1968, Toronto, Canada*. 489 pp.
- Hatcher, Harlan. 1944. *The Great Lakes*. Oxford University Press, New York. 384 pp.
- Hatcher, Harlan. 1945. *Lake Erie*. Bobbs-Merrill Co., Indianapolis. 416 pp.
- Havighurst, Walter. 1961. *The Long Ships Passing. The Story of the Great Lakes*. Macmillan, New York. 291 pp.
- Havighurst, Walter (ed.). 1966. *The Great Lakes Reader*. Macmillan, New York. 421 pp.
- Landon, Fred. 1944. *Lake Huron*. Bobbs-Merrill Co., Indianapolis. 398 pp.
- Malkus, Aldin. 1966. *Blue Water Boundary: Epic Highway of the Great Lakes and St. Lawrence*. Hasting House Publ., New York. 308 pp.
- McKee, R. 1966. *Great Lakes Country*. Thomas T. Crowell Co., New York. 242 pp.
- Nute, Grace. 1944. *Lake Superior*. Bobbs-Merrill Co., Indianapolis. 376 pp.
- Pound, Arthur. 1945. *Lake Ontario*. Bobbs-Merrill Co., Indianapolis. 384 pp.
- Quaife, Milo. 1944. *Lake Michigan*. Bobbs-Merrill Co., Indianapolis. 384 pp.

FEDERAL PUBLICATIONS CONCERNING THE LAKES

- Canadian Committee on Oceanography. 1968. *Directory and Project Forecasts, 1968. The Great Lakes and Other Large Lakes*. 137 pp. The Canadian Committee on Oceanography, Office of the Secretary, % Fisheries Research Board of Canada, Sir Charles Tupper Building, Confederation Heights, Ottawa 8, Ontario, Canada. Issued periodically.

- U.S. Corps of Engineers, Lake Survey District. 1968. *Directory and Project Forecasts. The Great Lakes*. 121 pp. Great Lakes Regional Data Center, U.S. Corps of Engineers, Lake Survey District, 630 Federal Building, Detroit, Mich. 48226. Issued periodically.

Lake Erie

- U.S. Bureau of Outdoor Recreation. 1966. *Water Oriented Outdoor Recreation, Lake Erie Basin*. 100 pp. Bureau of Outdoor Recreation, 3853 Research Park Drive, Ann Arbor, Mich. 48104.
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